JANUARY 1996

REPORT NO. 95-13

NUCLEAR SHIPPING AND STORAGE CONTAINERS WITH DEPLETED URANIUM (DU) SHIELDING DEPARTMENT OF TRANSPORTATION (DOT) CERTIFICATION TESTS

19960806 041

Prepared for:
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Savanna, Illinois

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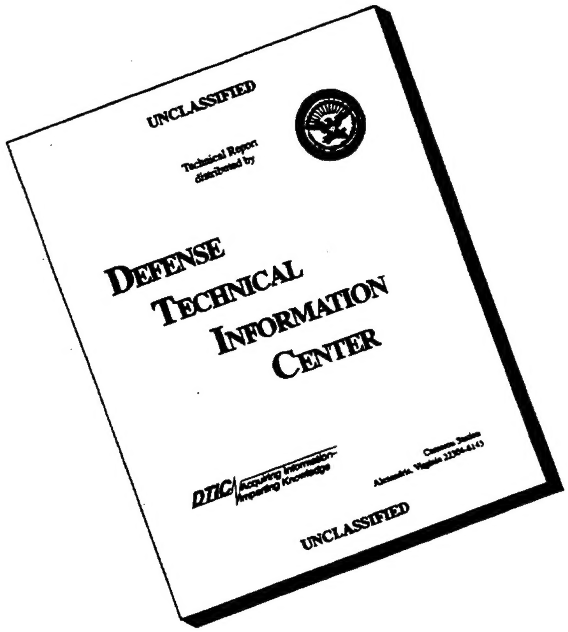

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Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT UNLIMITED
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 95-13	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Defense Ammunition Center and School 6b. OFFICE SYMBOL *(if applicable)* SIOAC-DEV	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS *(City, State, and ZIP Code)* ATTN: SIOAC-DEV Savanna, IL 61074-9639	7b. ADDRESS *(City, State, and ZIP Code)*
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Industrial Operations Command 8b. OFFICE SYMBOL *(if applicable)* AMSIO-SMA-N	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS *(City, State, and ZIP Code)* ATTN: AMSIO-SMA-N Rock Island, IL 61299-6000	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE *(Include Security Classification)*
Nuclear Shipping and Storage Containers with Depleted Uranium (DU) Shielding Department of Transportation (DOT) Certification Tests

12. PERSONAL AUTHOR(S)
William R. Meyer

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT *(Year, Month, Day)*	15. PAGE COUNT
Final	FROM ____ TO ____	1996 January	

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SIOAC-DEV), was tasked by Industrial Operations Command (IOC), AMSIO-SMA-N, to conduct Department of Transportation (DOT) tests on nuclear hazardous waste containers containing concrete and 30mm DU rounds for shielding. Two series of tests were conducted due to fluctuations in radiation levels experienced during the first series of tests. During the second series of tests no fluctuations in radiation were noted with only minor problems experienced with pressure leakage around the base of two of three containers. Except for the leakage noted above, no other problems were experienced with all containers meeting the other requirements for DOT shipping and storage containers. This report contains results of the tests conducted.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT XX UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL JEROME H. KROHN	22b. TELEPHONE *(Include Area Code)* 815-273-8929 22c. OFFICE SYMBOL SIOAC-DEV

DD Form 1473, Jun 86 *Previous editions are obsolete* SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
VALIDATION ENGINEERING DIVISION
SAVANNA, IL 61074-9639

REPORT NO. 95-13

NUCLEAR SHIPPING AND STORAGE CONTAINERS WITH
DEPLETED URANIUM (DU) SHIELDING
DEPARTMENT OF TRANSPORTATION (DOT) CERTIFICATION TESTS

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SIOAC-DEV), was tasked by Industrial Operations Command (IOC), AMSIO-SMA-N, to conduct Department of Transportation (DOT) tests on nuclear hazardous waste containers. This was a non-government proposal to dispose of excess Depleted Uranium (DU) rounds by incorporating them into the shielding material of nuclear containers. The intended use of these containers is for the commercial sector for shipment and storage of hazardous nuclear waste. If successful, the U. S. Government would realize a cost avoidance in disposal of excess DU rounds.

B. AUTHORITY. This program was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. OBJECTIVE. The objective of these tests was to determine if the proposed containers could meet DOT requirements for shipment and storage of nuclear waste.

D. CONCLUSION . As tested, the containers passed all tests except the .75 atm overpressure test, due to damaged seals and weld leaks around the base of two containers. The first series of tests showed some increases in radiation levels with the second series of tests showing no significant increases in radiation during testing. The design tested during the second series of tests was superior to the first, with very little cracking to the concrete seal that secures the internal vault. This improvement was due to a thicker concrete seal which incorporated the drum rib, and a 25 percent increase in the concrete/hematite used for the shielding.

E. RECOMMENDATIONS:

1. The containers used during production should be certified by the manufacturer to be leak-free at .75 atm or higher and supplied with more durable gaskets that are capable of being reused without leaking to improve the overall leak integrity of the containers.

2. The raw materials should be supplied with the container for sealing the internal cavity to ensure the seal integrity equals that of the tested containers.

PART 2

27-28 SEPTEMBER AND 11 OCTOBER 1995

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PART 3

TEST PROCEDURES

The following tests were extracted in part from Title 49 Code of Federal Regulations (CFR), section 173.401, Radioactive Materials.

1) Design requirements for Type A packages section 173.412

2) Type A packaging tests section 173.465.

3) The vibration test was extracted from Federal Standard 101, Method 5019.

A. HOT/COLD TESTS. The container was designed so that containment and shielding was maintained during transport and storage in a temperature range of -40 degrees Celsius (-40 degrees Fahrenheit) and 70 degrees Celsius (158 degrees Fahrenheit) with account being taken of the possibility of brittle fracture.

B. PRESSURE TEST. The container was designed so that the containment system retained its radioactive contents under the reduction of ambient pressure to .25 kilograms per square centimeter (3.5 pounds per square inch). Note: For smaller containers, vacuum testing simulates design requirements; for large containers, pressure testing to .75 atm simulates design requirements.

C. WATER SPRAY TEST. The water spray test precedes each test or test sequence. The water spray test simulates exposure to rainfall of approximately 5 centimeters (2 inches) per hour for at least one hour. The time interval between the end of the water spray test and the beginning of the next test is such that the water has soaked-in to the maximum extent without appreciable drying of the exterior of the specimen. In the absence of evidence to the contrary, this interval

may be assumed to be two hours if the water spray is applied from four different directions simultaneously. However, no time interval may elapse if the water spray is applied from each of the four directions consecutively. Note: This test is designed to pre-condition containers that are suceptible to moisture prior to testing such as cellulose materials; i.e., cardboard, pressboard, etc. For metal containers that are impervious to moisture, one test was conducted with the balance of tests passing by analogy.

D. FREE DROP TEST. The free drop test consisted of a fall onto the target in a manner that caused maximum damage to the safety features being tested and for packages weighing 5,000 kilograms (11,000 pounds) or less, the distance of the fall measured from the lowest point of the packaging to the upper surface of the target was not less than 1.2 meters (4 feet).
Note: Orientations of the package that cause the maximum damage to the container are as follows:

(1) Flat to the container side along the weld seam and in line with the bolt retaining the package lid.

(2) Flat to the package lid and cover retaining ring and bolt.

(3) 45 degrees to the package lid/side in line with the weld seam and bolt securing the package lid.

E. COMPRESSION TEST. The compression test lasted for a period of at least 24 hours and consisted of a compressive load equivalent to the greater of the following.

(1) Five times the weight of the actual package or

(2) 1300 kilograms per square meter (265 pounds per square foot) multiplied by the vertically projected area of the package. The compressive load was applied uniformly to two opposite sides of the packaging specimen, one was the base on which the package would normally stand.

F. <u>PENETRATION TEST</u>. For the penetration test, the packaging specimen was placed on a rigid, flat, horizontal surface that did not move while the test was being performed. The test consisted of a bar 3.2 centimeters (1.25 inches) in diameter, with a hemispherical end weighing 6 kilograms (13.2 pounds), being dropped with its longitudinal axis vertical, onto the center of the weakest part of the packaging specimen so that, if it penetrated far enough, it will hit the containment system. The bar must not be deformed by the test and the distance of the fall of the bar measured form its lower end to the upper surface of the packaging specimen was not less than 1 meter (3.3 feet).

G. <u>VIBRATION TEST</u>. The vibration test is not part of the DOT requirements; however, it was added to the test program to verify the transportability of these nuclear containers. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure was as follows: the test specimens (3 samples) were placed on, but not fastened to, the vibration platform. With the specimens in position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieves 1 +/- 0.1 Gs. Unless failure occurs, the total time of vibration is one hour.

H. <u>PASS/FAIL REQUIREMENT</u>. When the package is subjected to the tests specified in Title 49, CFR, section 173.465, or evaluated against these tests by any of the methods authorized be Title 49, CFR, section 173.461, the packaging will prevent the following:

(1) Loss or dispersal of the radioactive contents and

(2) Any significant increase in the radiation levels recorded or calculated at the external surfaces before and after testing. Title 49, CFR, section 173.401, Radioactive Materials, does

not define what significant increases in radiation will be; therefore, a 20 percent increase was selected to conform to Department of Energy (DOE), Westinghouse Inc., Hanford, Washington pass/fail requirements. To verify the pass/fail requirements set forth above, a florescent dust inspection test was used to verify no loss of contents and radiographic surveys were used to verify radiation levels before and after testing.

PART 4

TEST RESULTS

All containers tested used inert 30mm ammunition in lieu of 30mm DU rounds to avoid disposal of hazardous waste test samples. The length of the inert rounds were approximately 3 inches versus 5.5 inches for the DU rounds. All containers tested were furnished to USADACS by suppliers recommended by Stan A. Huber Consultants, Inc.

A. HOT/COLD TEST. During both the -40 degrees Fahrenheit cold test and the 158 degrees Fahrenheit hot test, no problems were encountered. This test was conducted to ensure compatibility of materials and ascertain the potential for brittle fracture at extreme temperatures. Following testing, all four containers had no leakage of contents or significant increases in radiation.

B. COMPRESSION TEST. The 24-hour compression test was conducted at 7,500 pounds. After the first compression test, the container had a small superficial crack on the concrete seal that secures the internal cavity (see photograph in Part 5). No cracks were detected during the second test. Following testing, neither container had any leakage of floresent dust or significant increases in radiation.

C. VIBRATION TEST. During the first series of tests, one container went through three 1-hour vibration tests with no problems encountered. During the second series of tests, three containers were tested for 1 hour each. The orientation during all tests was in the upright position, simulating normal transportation conditions. During the second series of tests, one container developed minor damage to the lower base rim due to the peening action of the vibration table during periods in which the sample reached resonant frequency. Typical accelerations during this test were 1 to 2 Gs in the vertical axis and 0.5 to 1.0 Gs in the

longitudinal and lateral axis, (see graphs in Part 7). Following testing, all four containers experienced no loss of florescent dust or significant increases in radiation.

D. PRESSURE TEST. During the first series of tests, one container with a new seal was pressurized to 11.5 psi with helium to simulate a .75 atm overpressure. After pressurization, a mass spectrometer was used to inspect all weld seams as well as the lid gasket sealing area. No leaks were encountered at the 1 X 10^{-6} cc/he/sec/11.5 psi sensitivity level. During the second series of tests, three containers were pressurized as described above and again inspected with a mass spectrometer. All three containers showed some leakage of the gasket around the rim sealing area. This leakage was due to reuse of previously-used gaskets, with all gaskets showing some damage prior to this test. Two containers also had some leakage around the bottom weld seam.

E. WATER SPRAY TEST. During the first series of tests, one container was placed into a water spray chamber and subjected to a simulated rainfall of 2 inches per hour from four different angles, 90 degrees apart. The duration of the test was 1 hour with the container passing this test with no problems encountered. This test was not repeated during the second series of tests due to the imperviousness of moisture on metal containers.

F. PENETRATION TEST. During the first series of tests, one container was subjected to a 13.4-pound, 1.25-inch diameter steel bar with a hemispherical end dropped from 3.3 feet. The first impact was to the container lid with a small permanent deformation noted. The second impact was to the container body with no indentation occurring. The container passed both tests with no problems encountered. This test was not repeated during the second series of tests due to the lack of damage noted during the first series of tests.

G. <u>FREE FALL DROP TESTS</u>. Three drop tests were conducted from four feet in the following order for both series of tests:

(1) Flat to the container side with impact on the weld seam.

(2) Flat to the container lid.

(3) 45 degrees to the container lid and body.

During the first series of tests, one container was dropped twice with the first two orientations listed above and the other container was dropped once 45 degrees to the lid. During the first series of drops, cracks to the concrete shielding were noted on both containers with no loss of contents (see photographs in Part 5). During this drop test, the container experienced 24 Gs when dropped flat to its side, 24 plus Gs when dropped flat to the container lid and 22 Gs vertical and 17 Gs longitudinal when dropped 45 degrees to the lid (see graphs in Part 7).

During the second series of tests with the drop flat to the container side, only minor damage to the container body was noted with more damage to the rim, bolt, and lid as would be expected. After the drop flat to the container lid, approximately one-third of the lid rim was rolled up and under the drum rim with the drum edge collapsed and flush with the concrete interior. After the drop 45 degrees to the lid and side, the lid retaining ring popped off, with the cover remaining intact and only minor concrete pulverization to the impact area. The second series of tests did not experience the same concrete cracking as noted during the first series of tests with only minor damage noted to the concrete after testing (see photographs in Part 5).

Following all impacts, the lids were removed and inspected with a black light for leakage of florescent dust located in the internal cavities, none was detected. During the first series of tests, several sites showed increases in radiation above 20 percent and believed to be due to the shifting of the inert load during testing; however; no significant radiation increases were noted during the second series of tests.

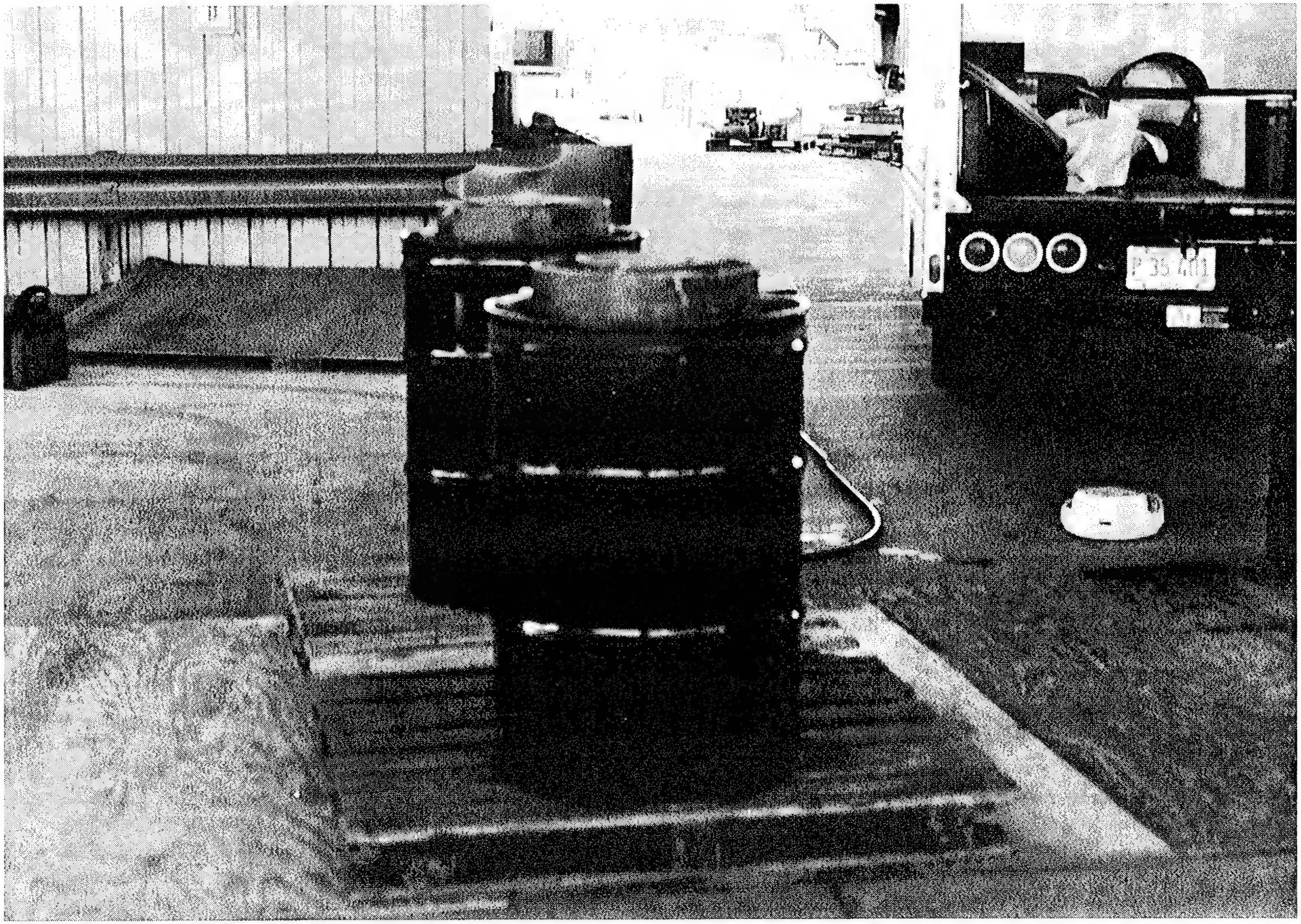
H. RADIOGRAPHIC SURVEYS. Before and after each test, the shield integrity was checked at 20 different sites on the exterior of each container to determine if any deterioration had taken place (see drawing in Part 6).

During the first series of tests, a 33 curie source was used to inspect each container. Following testing, both samples showed significant increases in radiation above 20 percent at two locations. Container 1 (yellow) at site 9 went from 225 mr to 300 mr after testing and container 2 (red) at site 11 went from 30 mr to 55 mr. Three other sites (1, 2, and 3) on container 2 (red) had radiation fluctuations between 2 and 5.5 mr and are not considered significant due to their low mr readings as well as being a factor of 100 smaller than the hottest spots on the containers; namely, the center of the drum at sites 6, 9, 12, and 15. From the radiographic surveys it was concluded that the containers failed radiation tests due to settling of the inert load (steel shot) and not because of the container design. As an example, when the container was rotated 90 degrees, increases and decreases in radiation were noted as the steel shot shifted inside the cavity. During the second series, a resin was added to the steel shot to solidify the inert load with an 8 curie source being used to inspect the containers. By reviewing the radiographic readings located in Part 8 it can be noted that no significant increases of radiation occurred during any phase of testing, with many readings less than 5 mr during all phases of testing. Higher readings were noted around the 360 degree band on the center one-third of the container, where the shielding is thinnest, with readings in the 40 to 50 mr range. During the second test, none of the readings exceeded the 20 percent increase allowed under the pass/fail requirement. It should be noted that the source used during the second test was approximately 5.5 times weaker than the first test to reduce the radiation hazard (exposure) to workers. As a result, the lowest readings (top and bottom) of the containers with the thickest shielding were reported as less than 5 mr or the lowest detectable reading on the instrumentation being used. This approach was also taken to minimize operator error, fluctuations in

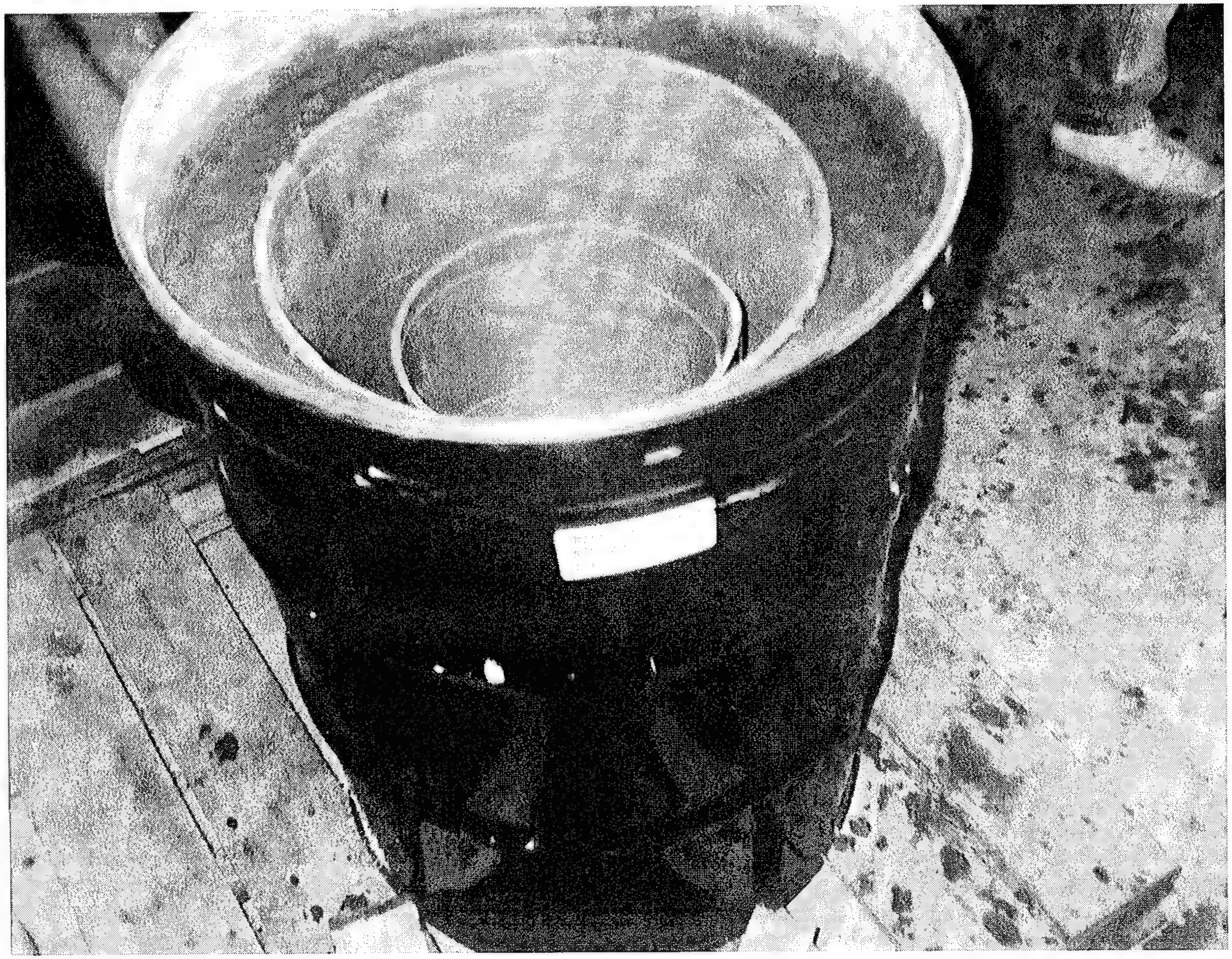
instrumentation sensitivity, position of instrument in relation to the spot being monitored, and slight changes in the position of the source during testing, all of which have a major impact on low-level mr readings. Again, these low readings become insignificant when compared to the hottest spots on the container bodies, where personnel would experience the greatest health risk.

PART 5

PHOTOGRAPHS



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-31-2591. This photos shows an overall view of construction of test samples.		



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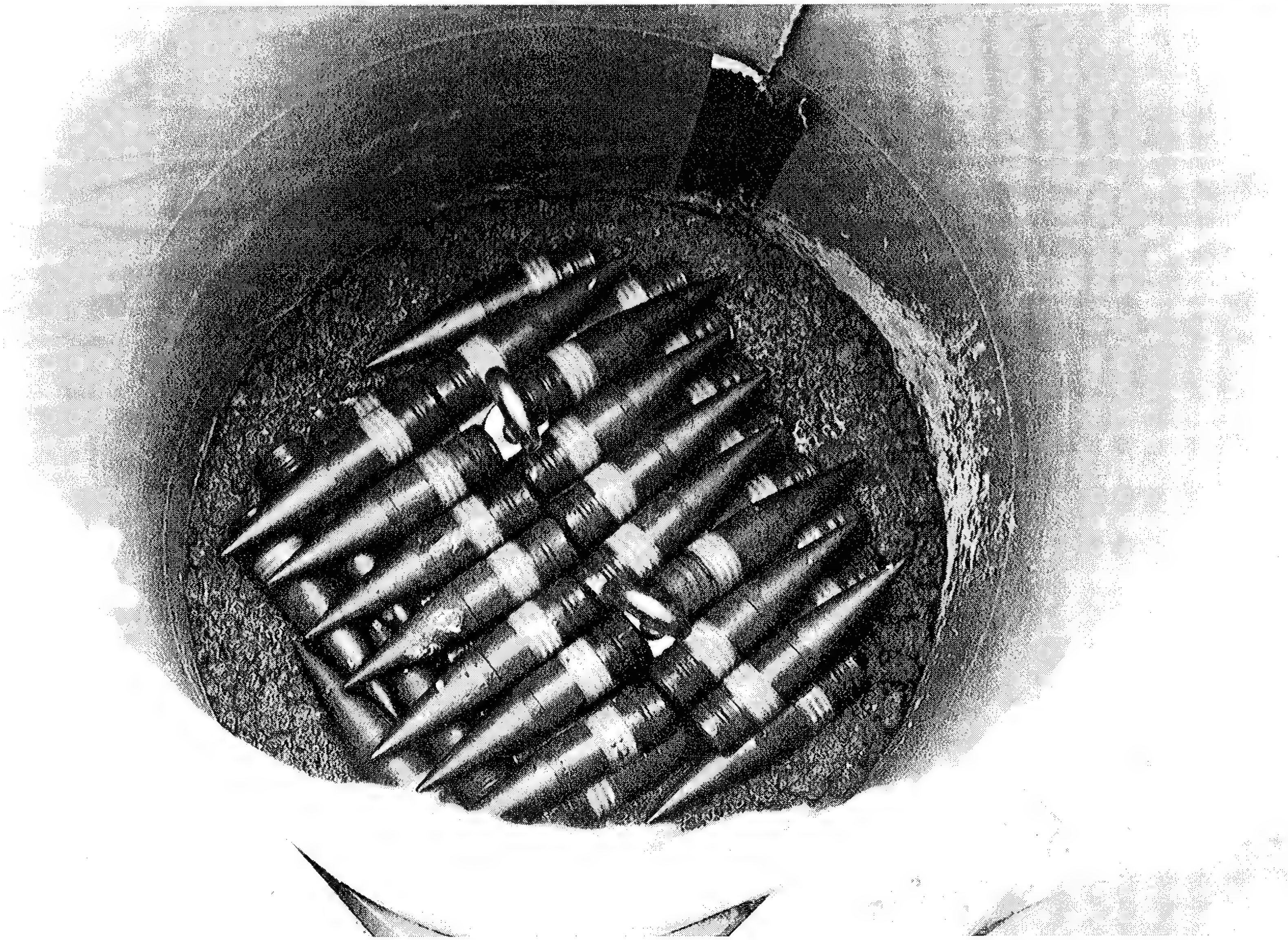
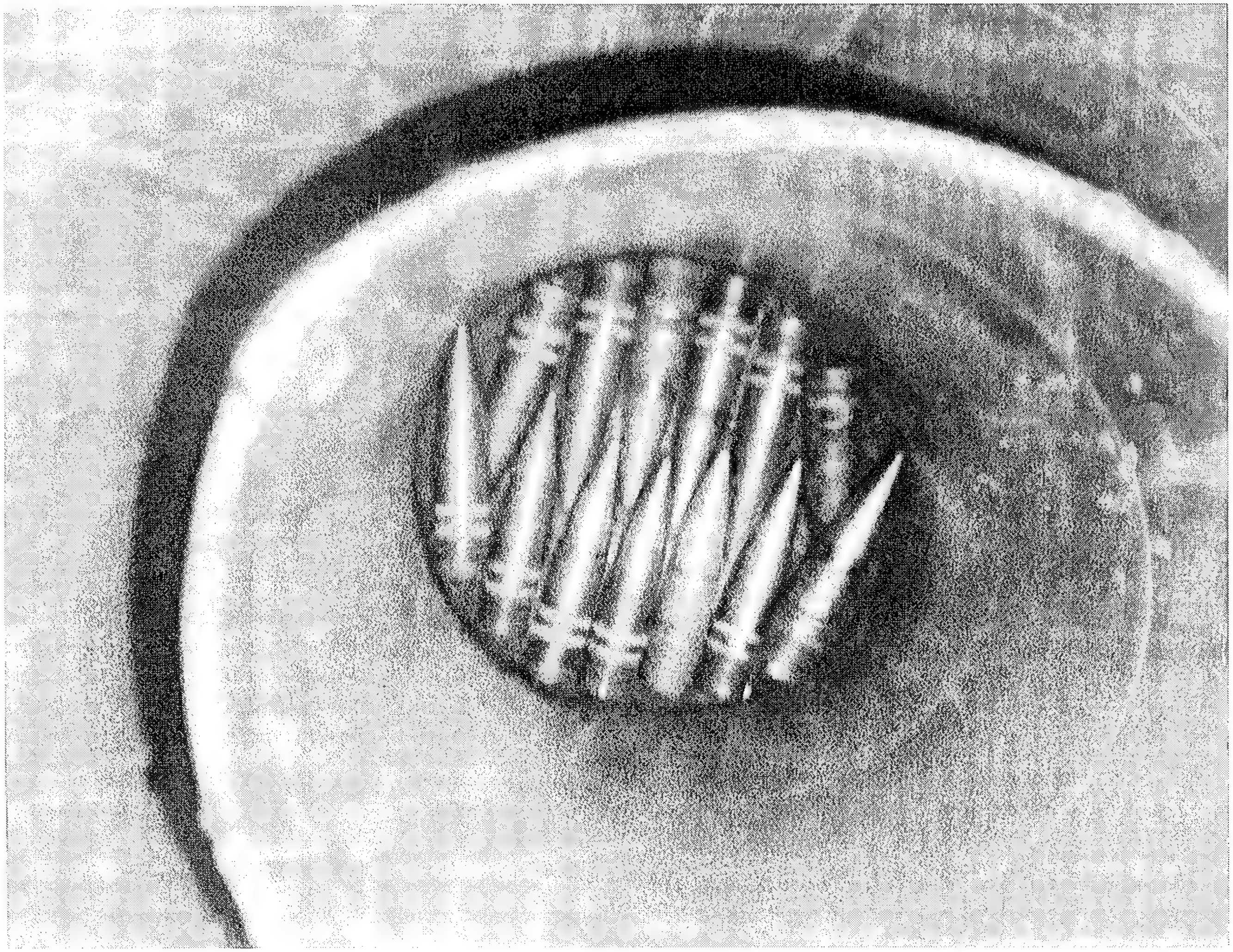
AO317-SPN96-28-668. This photo shows a closeup view of the sono tubes used to retain the concrete shielding.

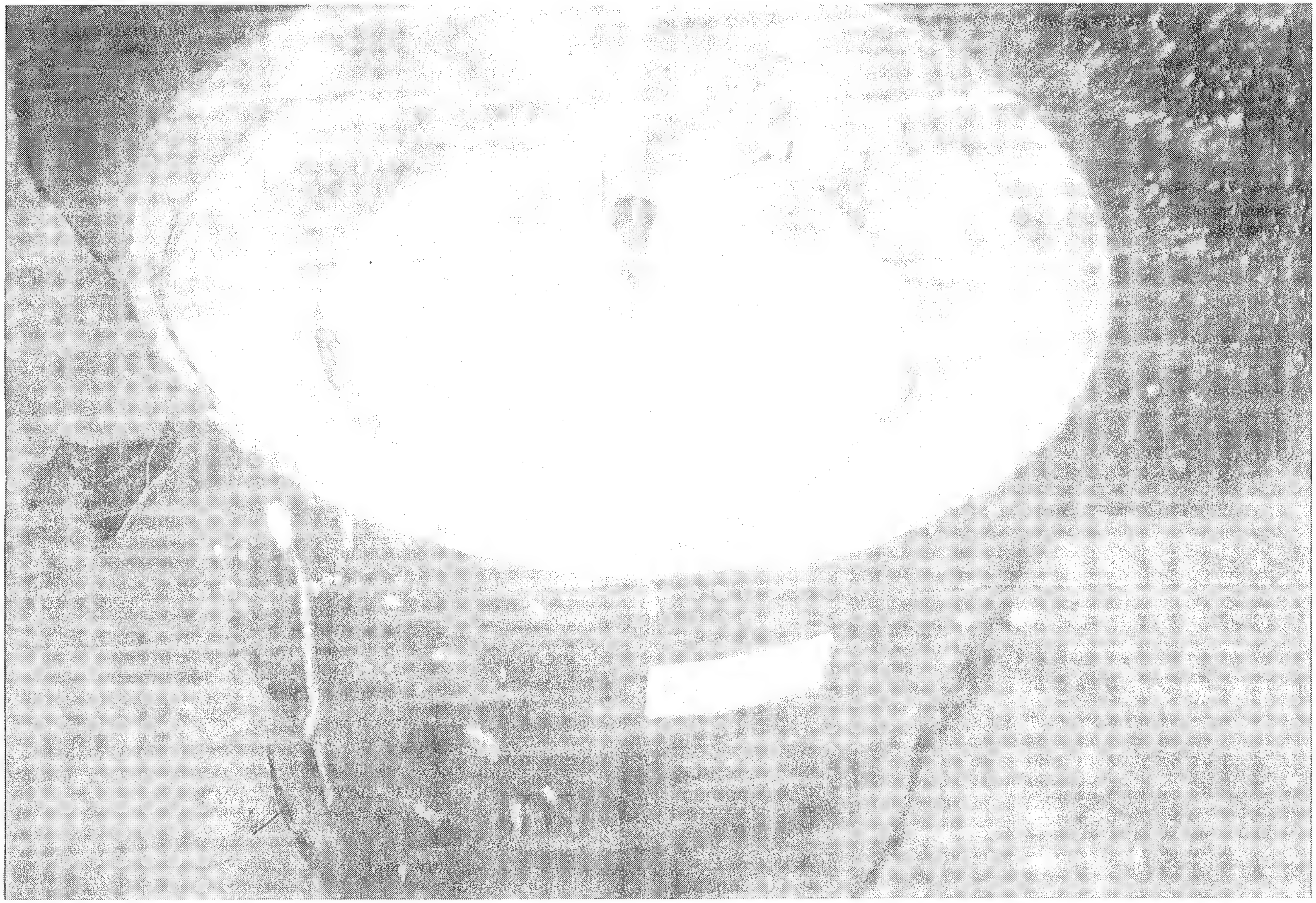


	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	

AO317-SCN95-31-2599. This photo shows a closeup view of the fabrication of the cover used to encapsulate the hazardous waste cavity.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SPN96-28-673. This photo shows a closeup view of 30MM inert ammunition at the bottom of the internal cavity prior to enclosure with concrete.		



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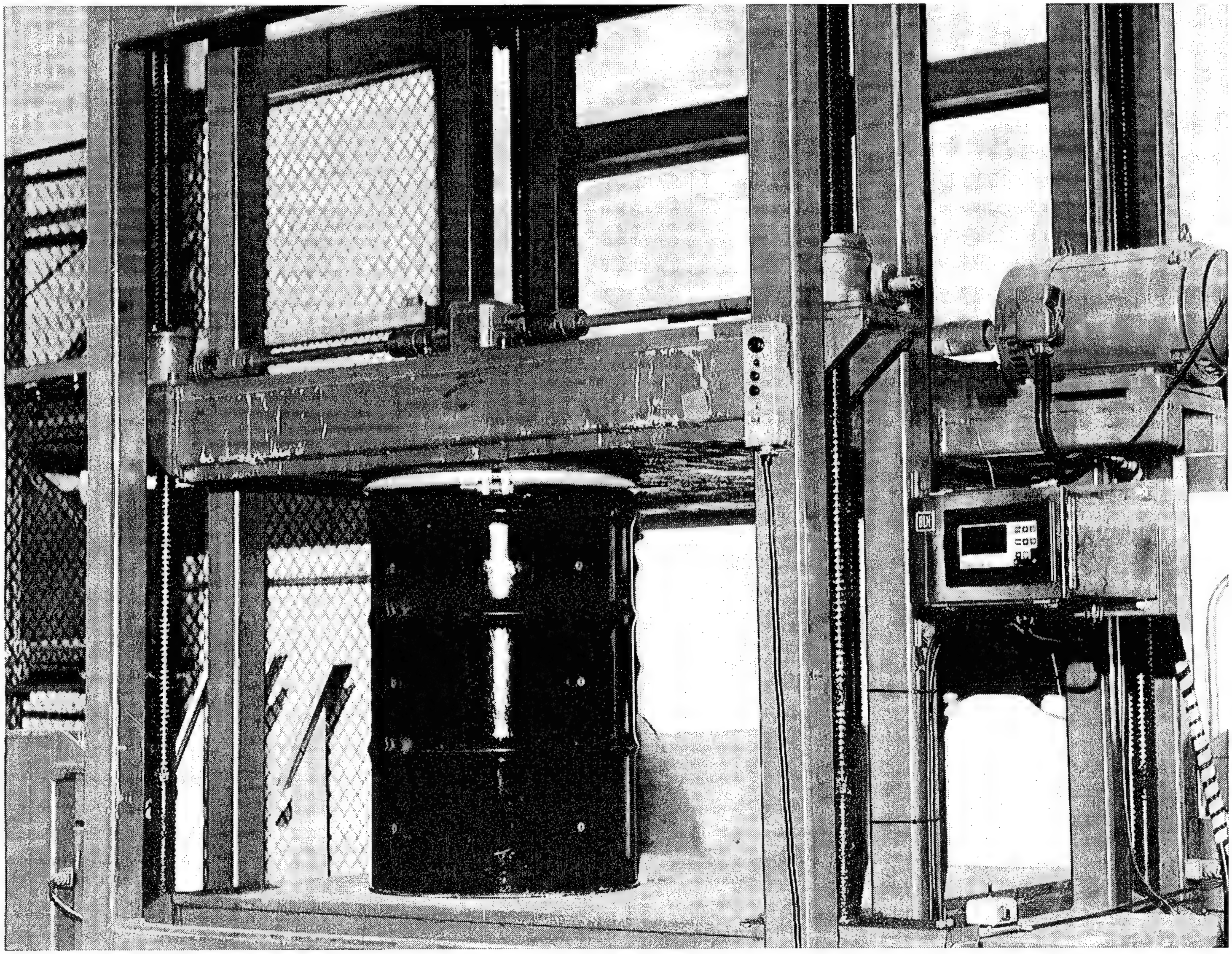
AO317-SPN96-28-694. This photo shows the closeup view of the test port used to insert the radiation source for radiographic measurements.

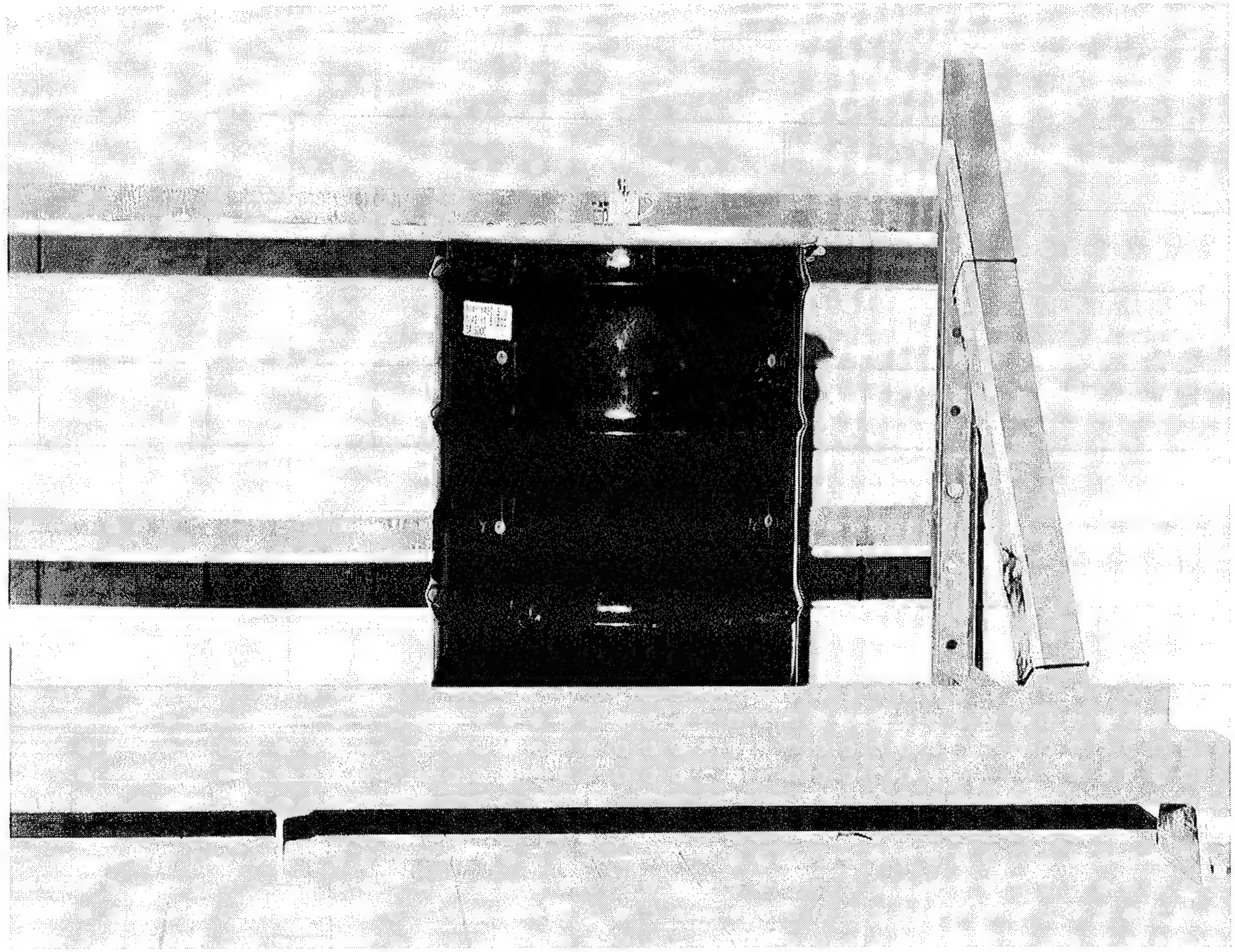
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	

USADACS-DEV-95-13-01. This photo shows a closeup view of one test sample following removal from the cold soak chamber at -40 degrees Fahrenheit.



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

AO317-SCN95-173-2155. This photo shows an overview of the compression test conducted on the hazardous waste containers.



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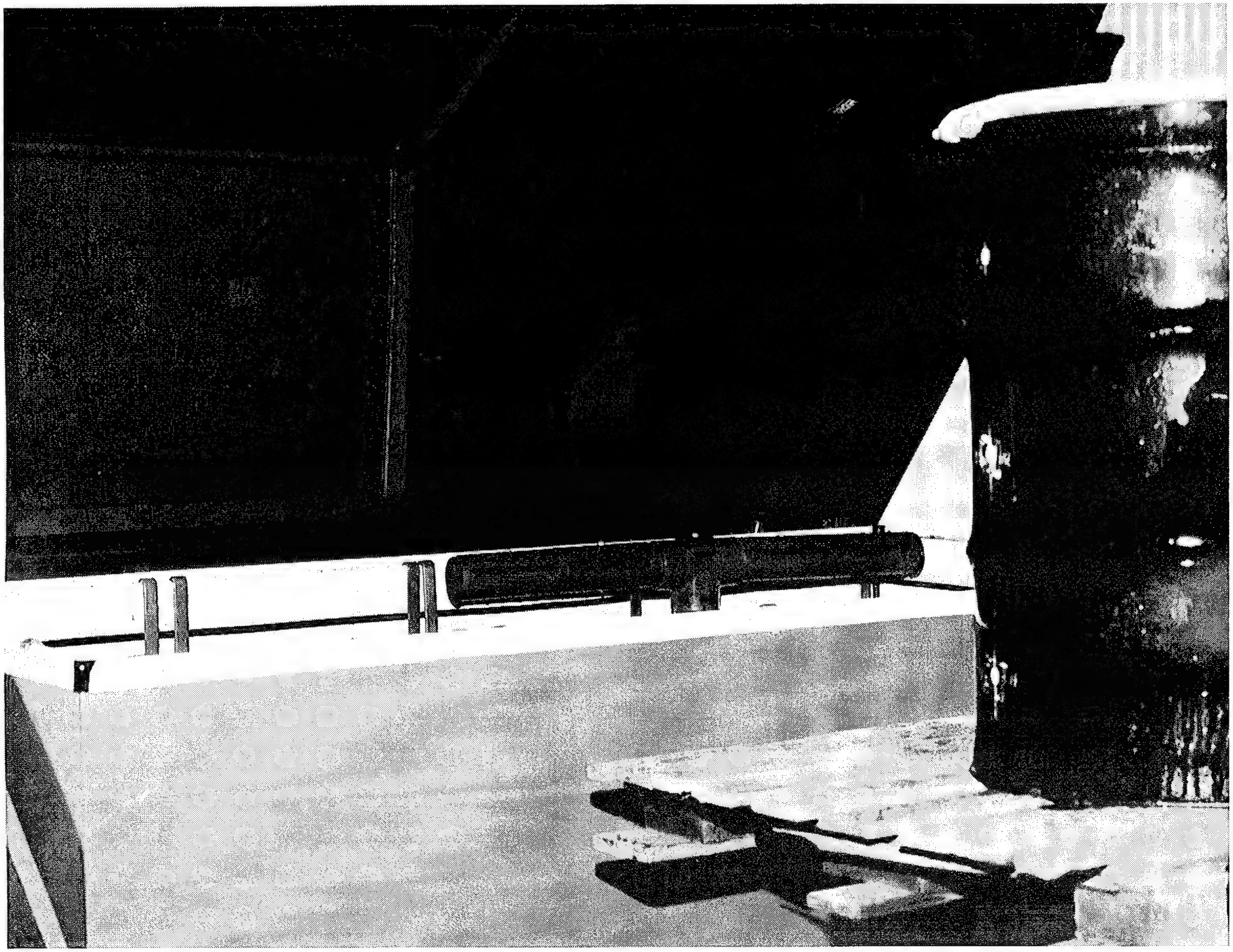
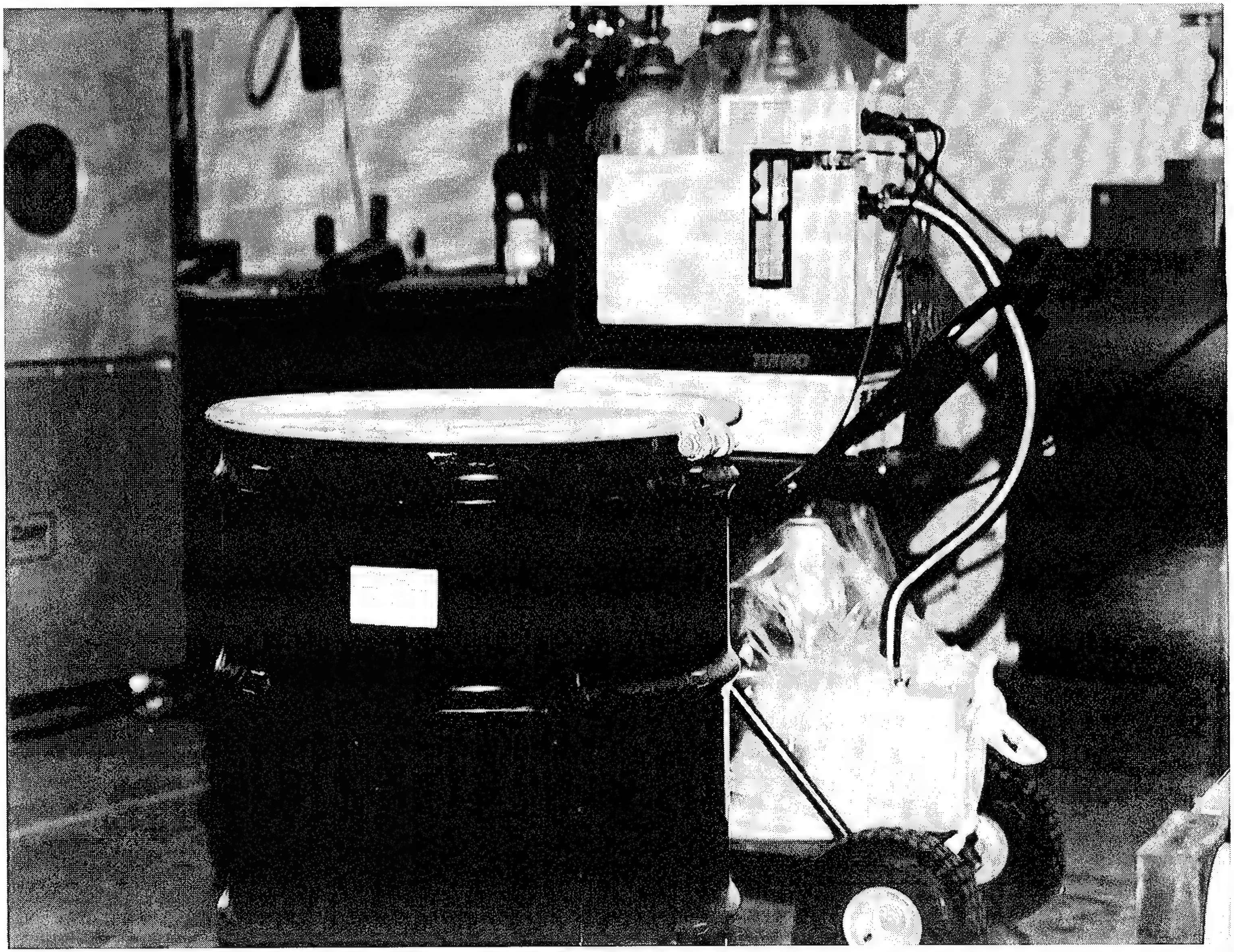
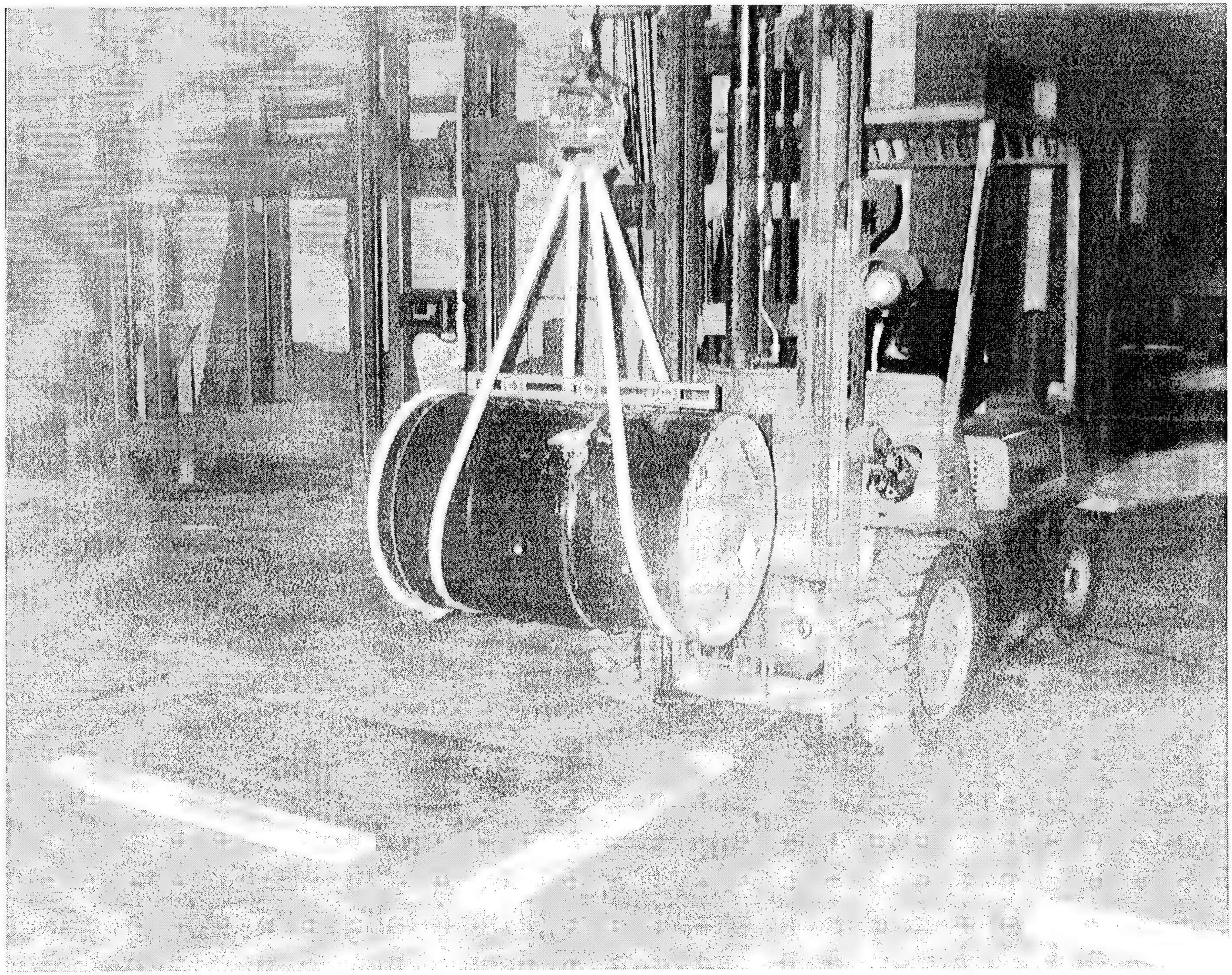
AO317-SCN95-173-2242. This photo shows an overview of the vibration test used during these series of tests. Note the accelerometer block on top of the test sample with vertical and horizontal transducers installed.



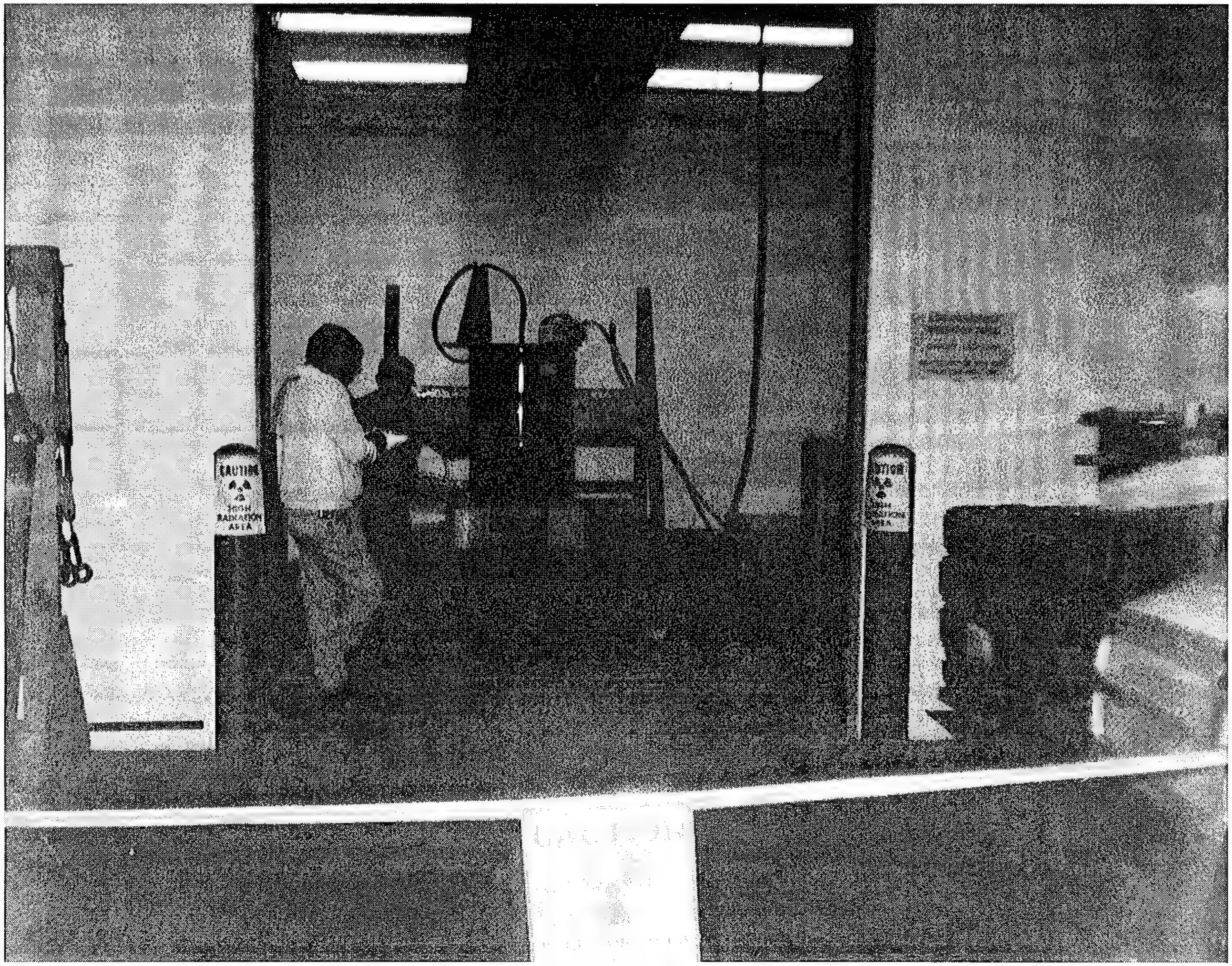
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-173-2164. This photo shows the test sample prior to placement into the water soak chamber.		



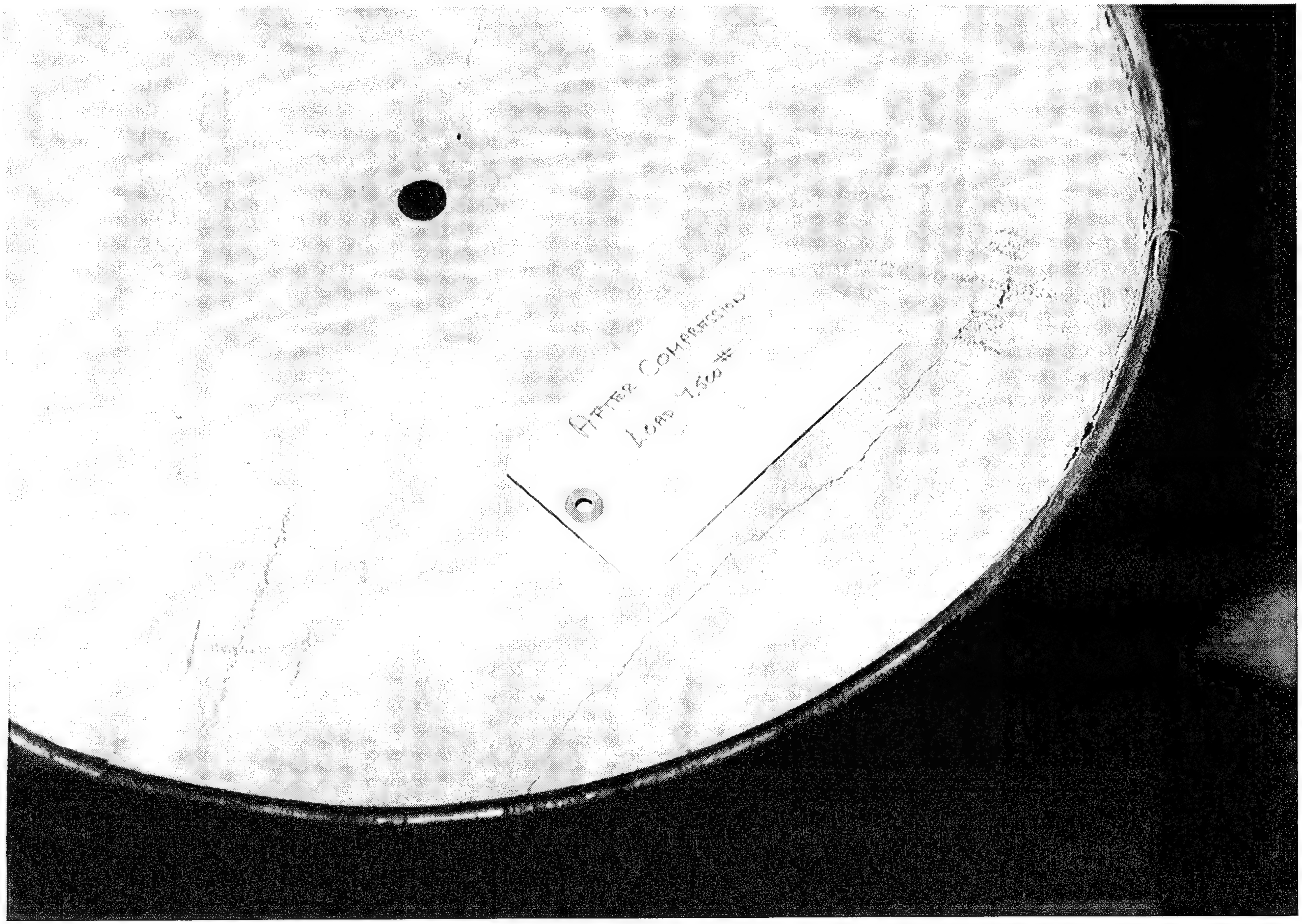
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-173-2245. This photo shows the test setup used to perform leak testing on the hazardous waste containers. Note the helium mass spectrometer with sampling probe in the background.		



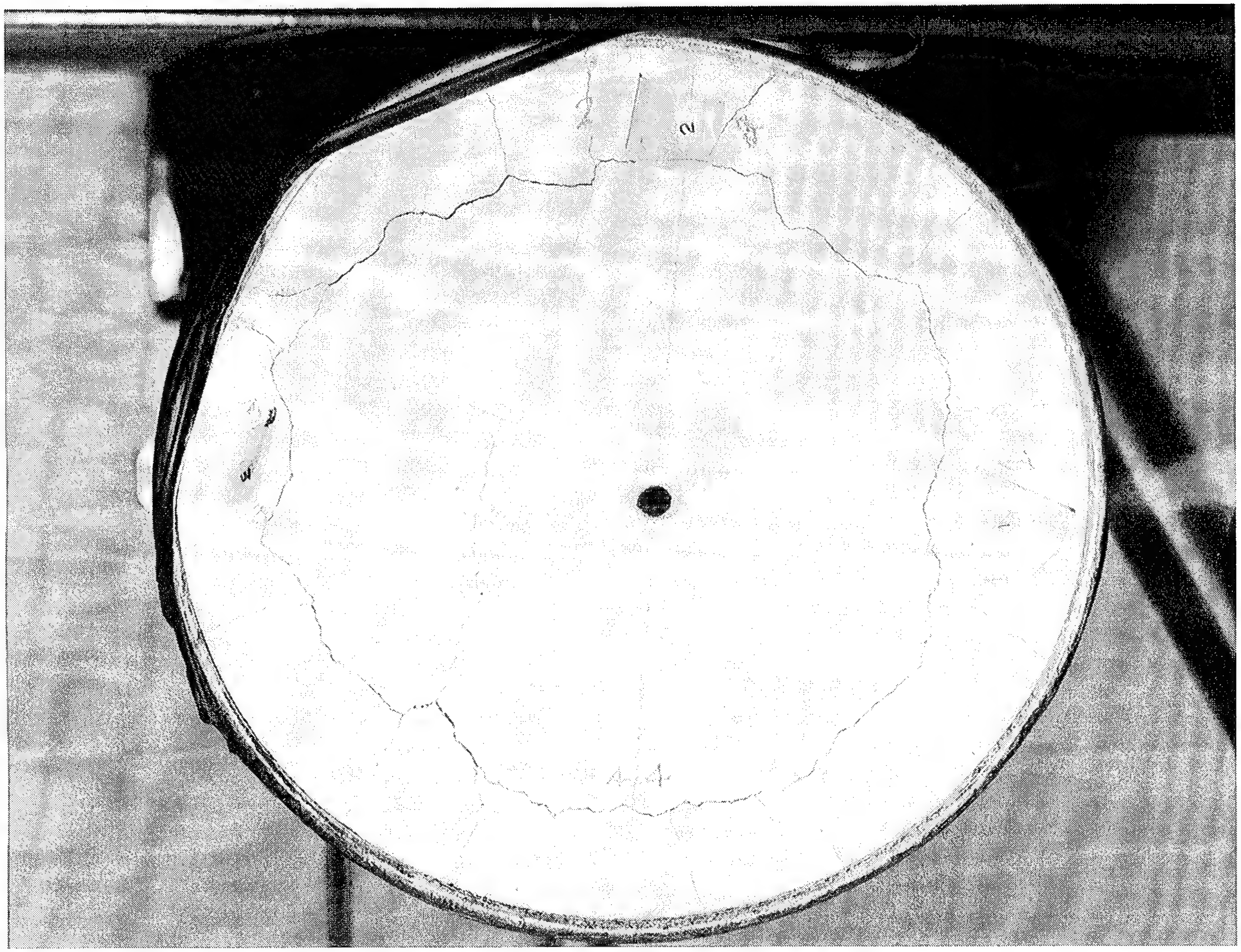
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
USADACS-DEV-95-13-02. This photo shows an overview of the test setup used during drop tests.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
USADACS-DEV-95-13-03. This photo shows an overview of radiographic surveys being conducted on test samples both before and after testing.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
AO317-SCN95-173-2152. This photo shows a crack that developed in a container during test no. 1 after the compression test.		



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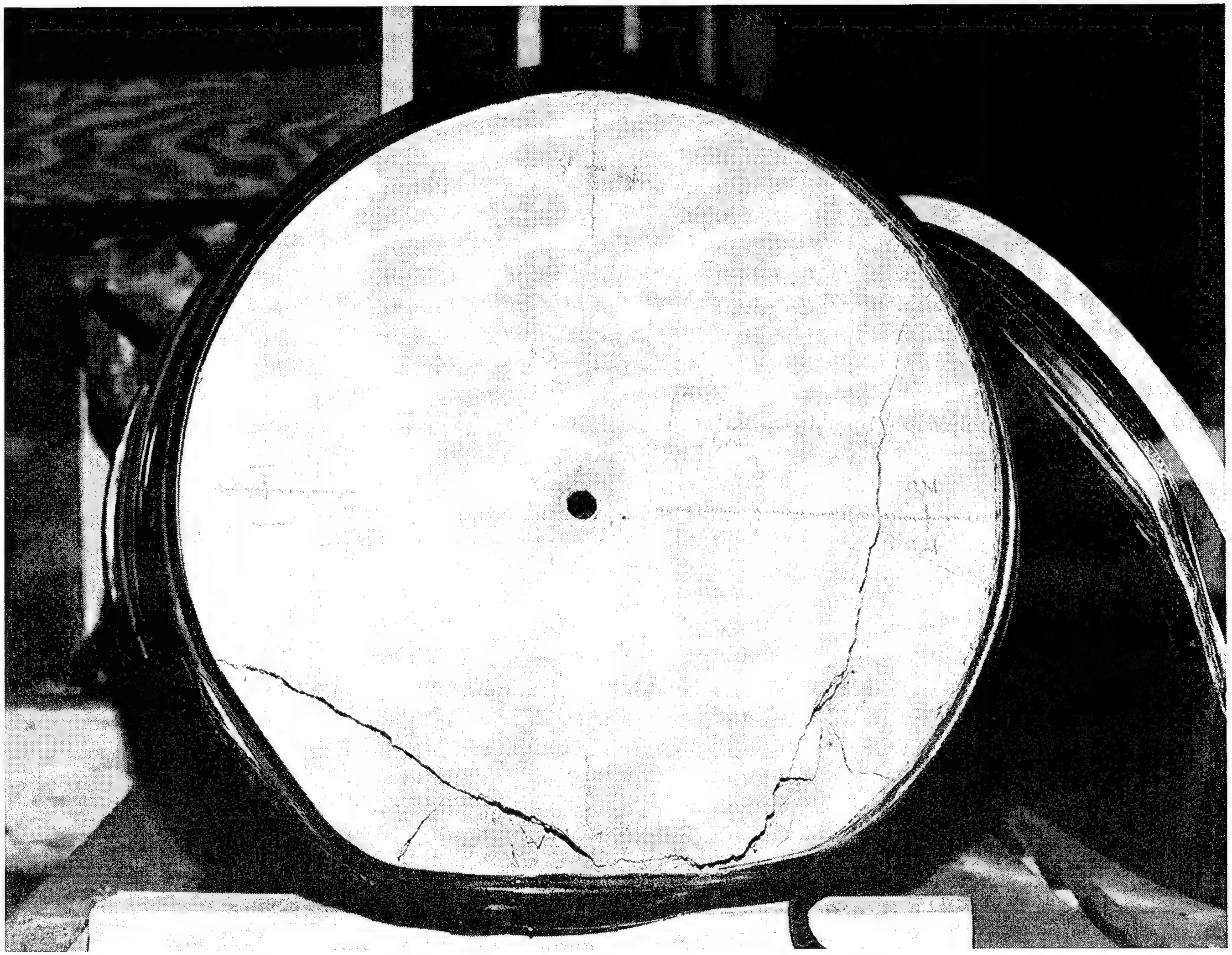
AO317-SCN95-173-2249. This photo shows damage sustained after two drops flat to the container side as well as flat to the top of the container during the first series of tests.



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AO317-SCN95-173-2248. This photo shows damage to the side of the container resulting after the 45 degree angle drop test during the first series of tests.

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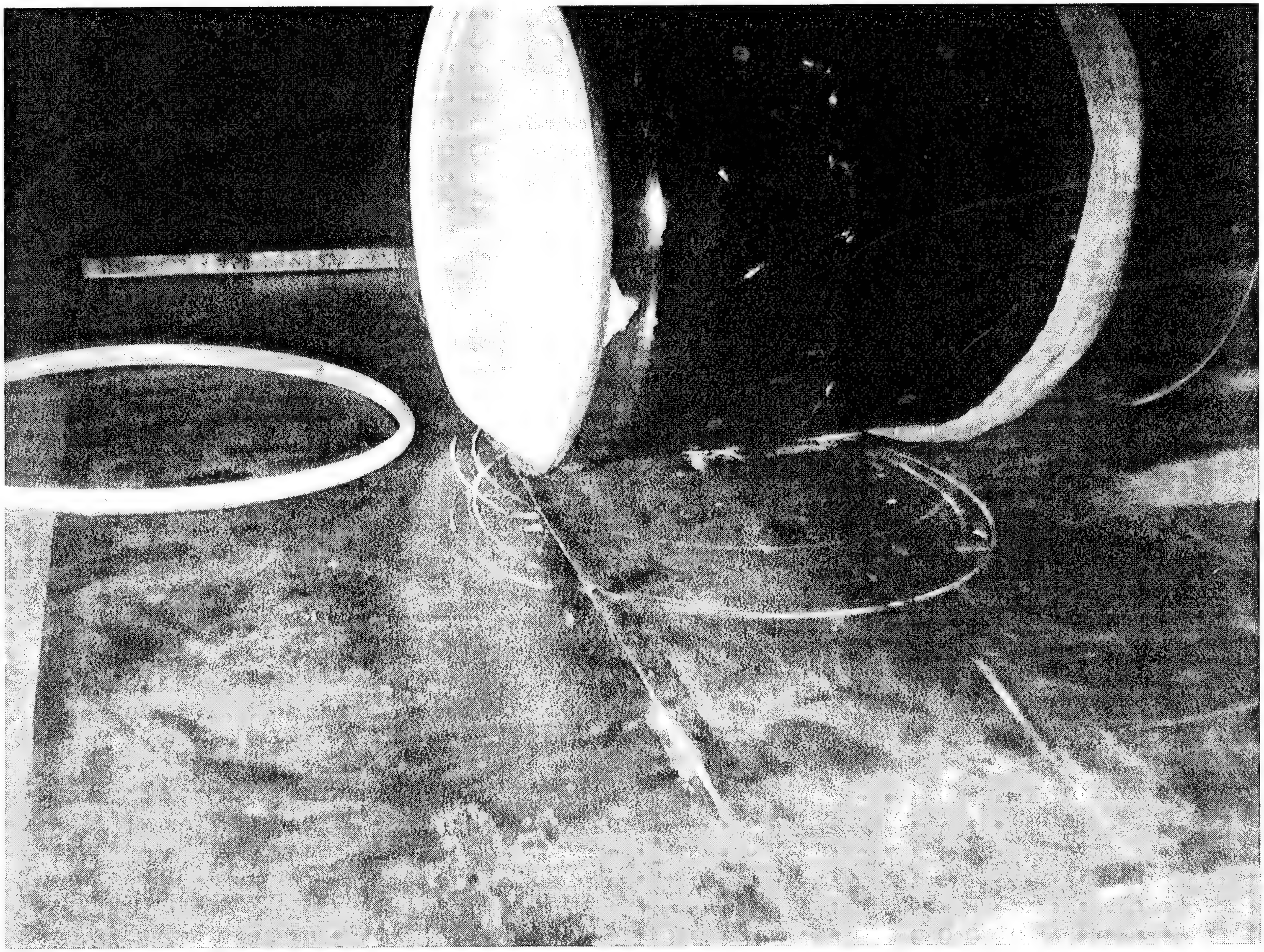
USADACS-DEV-95-13-04. This photo shows damage to the container after the vertical drop test during the second series of tests.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
USADACS-DEV-95-13-05. This photo shows damage to the container after the 45 degree angle drop test during the second series of tests.		

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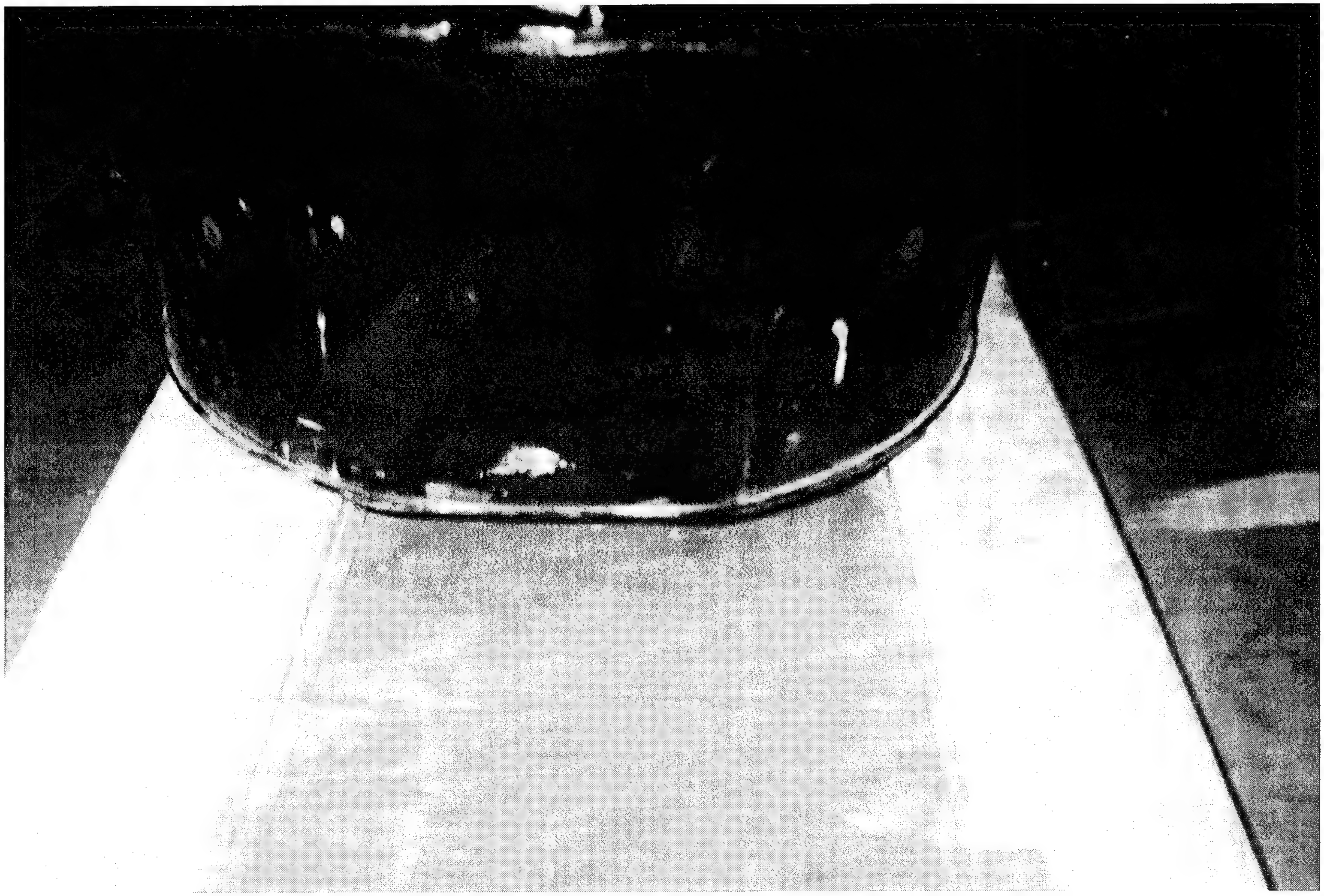
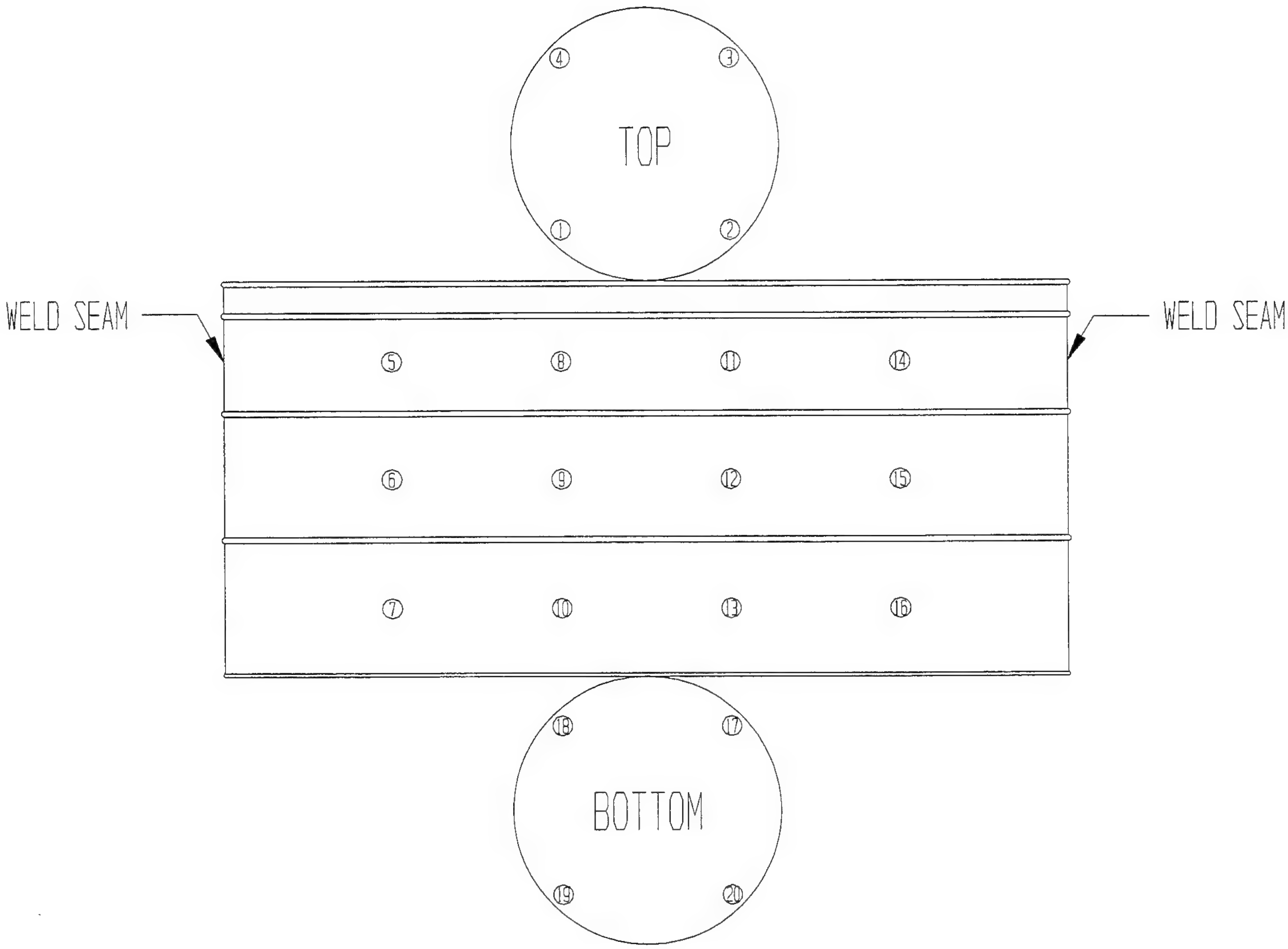
USADACS-DEV-94-13-06. This photo shows damage to the container after the 45 degree angle drop test during the second series of tests.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
USADACS-DEV-94-13-07. This photo shows damage to the container after the 45 degree angle drop test during the second series of tests.		

PART 6

DRAWINGS



DEPLETED URANIUM SHIELDED
CONTAINER RADIATION TEST POINTS

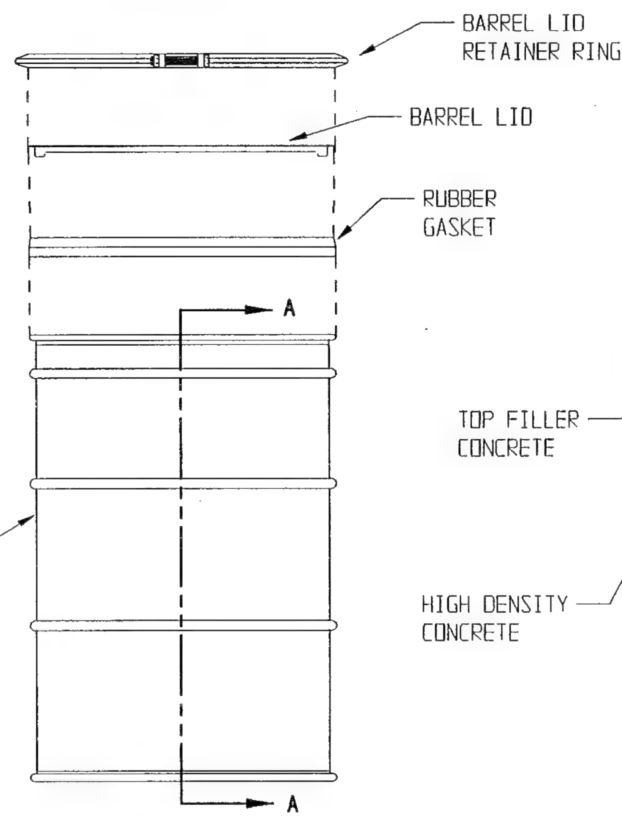
TRS/01-12-96

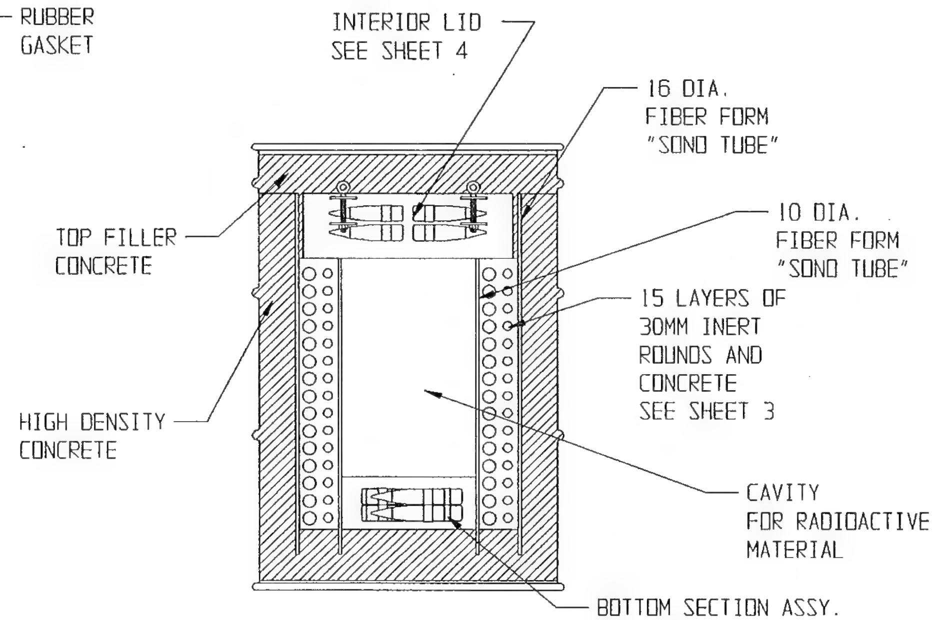
REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

NOTES:

1. 55 GAL DRUM WILL CONTAIN 283-30MM INERT ROUNDS ENCASED IN CEMENT. (NUMBER OF ROUNDS WILL BE LOWER FOR PRODUCTION DRUM DUE TO THE INCREASE IN SIZE OF PRODUCTION ROUNDS. SEE DRAWING SHEET 6). 55 GAL STEEL DRUM
   SPEC: UN PART# A21Y1.5/150/91
   GSA PART# CQ5507

2. CONCRETE MIX SPECIFICATIONS SEE SHEET 8.





SECTION A-A

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

PART NO ACV00282-1

DISTRIBUTION STATEMENT.

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UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. BREAK SHARP CORNERS AND EDGES. TOLERANCES ON FRACTIONS ± 1/8 DECIMALS ±	
MATERIAL	
NEXT ASSY	USED ON
APPLICATION	

DATE 96-01-17		
DFTSMN SKK	CHECKER WM	PROJ ENGR W. MEYER
SIOAC-DEV WRM JHK	THOMAS J. MICHELS CHIEF, SUPPLY ENGINEERING DIV	
SUBMITTED WILLIAM F. ERNST CHIEF, LOGISTICS ENGINEERING OFFICE		
APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC) GARY W. ABRISZ U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL		

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

TEST CONTAINER FOR
30MM INERT DEPLETED
URANIUM ROUNDS

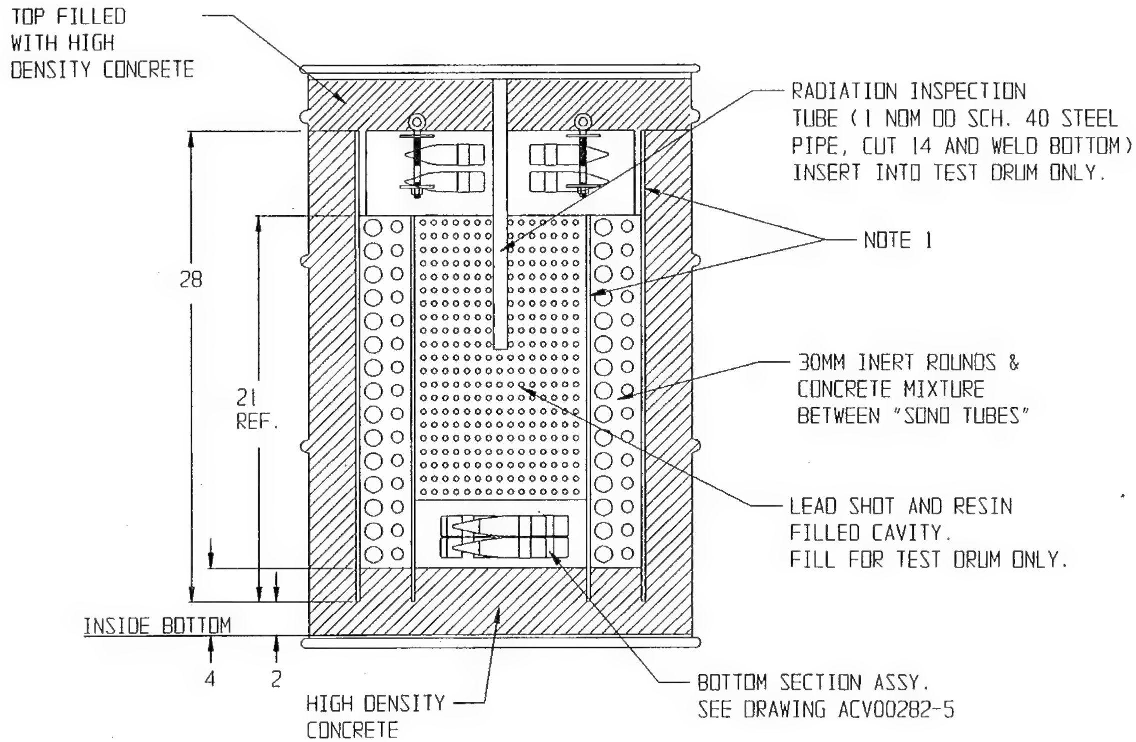
SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 1 OF 8

REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

NOTE:

DRAWING OF TEST DRUM

1. 1/4 INCH THICK FIBER FORM "SONO TUBE" FOR SPECIFICATIONS, SEE DRAWING ACV00282-7.



THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

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TOLERANCES ON
FRACTIONS ±1/8
DECIMALS ±
MATERIAL

DATE	96-01-17	
DFTSMN SKK	CHECKER WM	PROJ ENGR W. MEYER
STDAC-DEV WRM JHK	THOMAS J. MICHELS CHIEF, SUPPLY ENGINEERING DIV	
SUBMITTED	WILLIAM F. ERNST CHIEF, LOGISTICS ENGINEERING OFFICE	
APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC)	GARY W. ABRISZ U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL	

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

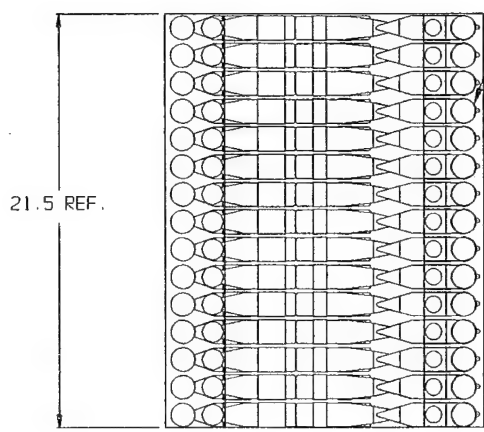
TEST CONTAINER
30MM INERT DEPLETED
URANIUM ROUNDS

SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 2 OF 8

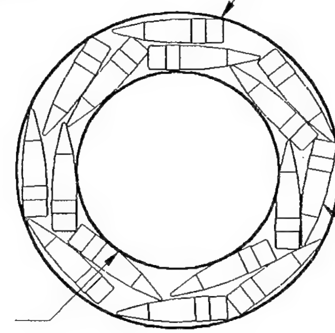
REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

NOTE:

1. DRAWING SHOWS 30MM INERT ROUND LAYERS AND CONCRETE MIXTURE BETWEEN THE TWO "SONO TUBES"; 15 LAYERS ARE REQUIRED, AS TESTED THE ROUND LAYERS WERE NOT AS UNIFORM AS DEPICTED.



NOTE 1
225 TOTAL 30MM INERT ROUNDS SUSPENDED IN CONCRETE, PLACED BETWEEN THE TWO "SONO TUBES".



16 DIA.
"SONO TUBE"

ONE LAYER OF 30MM INERT ROUNDS. (15 ROUNDS PER LAYER)

10 DIA.
"SONO TUBE"

SECTION SHOWING LAYOUT OF ONE LAYER OF 30MM INERT ROUNDS IN BETWEEN THE TWO "SONO TUBES."
NOTE: 15 LAYERS ARE REQUIRED.

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

PART NO ACV00282-3

DISTRIBUTION STATEMENT.

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NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. BREAK SHARP CORNERS AND EDGES.
TOLERANCES ON
FRACTIONS ±1/8
DECIMALS ±
MATERIAL

DATE 96-01-17
DFTSMN SKK | CHECKER WM | PROJ ENGR W. MEYER
SIDAC-DEY WRM JHK | THOMAS J. MICHELS, CHIEF, SUPPLY ENGINEERING DIV
SUBMITTED WILLIAM F. ERNST, CHIEF, LOGISTICS ENGINEERING OFFICE
APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC)
GARY W. ABRISZ
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

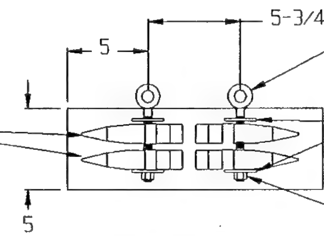
TEST CONTAINER
30MM INERT DEPLETED URANIUM ROUNDS

SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 3 OF 8

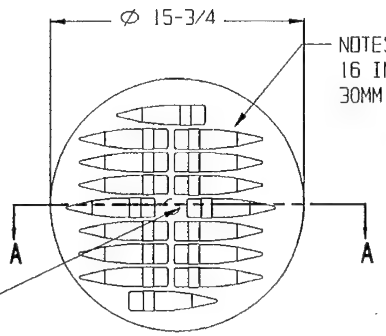
REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

NOTES:

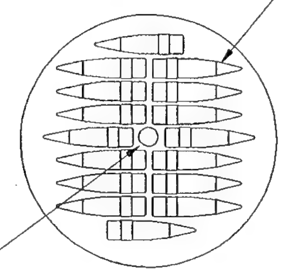
1. TWO LAYERS OF 30MM INERT ROUNDS SUSPENDED IN CONCRETE; BOTTOM LAYER CONSISTING OF 16 INTERLOCKING 30MM INERT ROUNDS ON A FOUNDATION OF 1 INCH CONCRETE AS SHOWN, THEN PLACE 1 INCH OF CONCRETE AND 16 MORE INTERLOCKING 30MM INERT ROUNDS FOR TOP LAYER.
2. FOR CONCRETE MIX SPECIFICATIONS SEE SHEET 8.
3. RADIATION INSPECTION TUBE REQUIRED FOR TEST DRUM ONLY.
4. FOR 30MM INERT ROUND SPECIFICATION SEE SHEET 6.



SECTION A-A



TOP LAYER ARRANGEMENT



BOTTOM LAYER ARRANGEMENT

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

PART NO ACV00282-4

DISTRIBUTION STATEMENT

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APPLICATION

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TOLERANCES ON
FRACTIONS ± 1/8
DECIMALS ±
MATERIAL

DATE 96-01-17
DFTSMN SKK | CHECKER WM | PROJ ENGR W. MEYER
STDAC-DEV WRM JHK | THOMAS J. MICHELS, CHIEF, SUPPLY ENGINEERING DIV
SUBMITTED WILLIAM F. ERNST, CHIEF, LOGISTICS ENGINEERING OFFICE
APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC)
GARY W. ABRISZ
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

TEST CONTAINER
30MM INERT DEPLETED
URANIUM ROUNDS

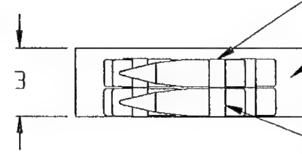
SIZE C | CAGE CODE 28620 | ACV00282
SCALE NONE | UNIT WT | SHEET 4 OF 8

NOTES:

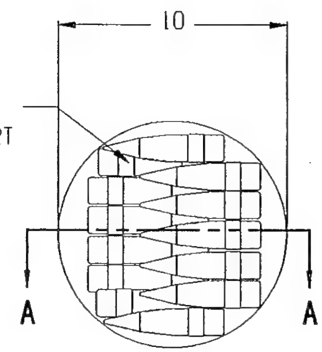
1. TWO LAYERS OF 30MM INERT ROUNDS ARE SUSPENDED IN CONCRETE. FOR BOTTOM LAYER; PLACE (13) 30MM INERT ROUNDS INSIDE 55 GAL DRUM AS SHOWN ON DRAWING SHEET 2, ARRANGE ROUNDS AS INDICATED. THEN PLACE 13 MORE 30MM INERT ROUNDS AS SHOWN IN TOP LAYER.

2. FOR CONCRETE MIX SPECIFICATION SEE DRAWING SHEET 8.

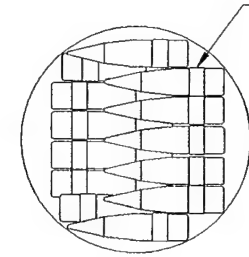
REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	



SECTION A-A



TOP LAYER



BOTTOM LAYER

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

PART NO ACV00282-5

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NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. BREAK SHARP CORNERS AND EDGES.
TOLERANCES ON
FRACTIONS ±1/8
DECIMALS ±

MATERIAL

DATE 96-01-17

DFTSMN	CHECKER	PROJ ENGR
SKK	WM	W. MEYER

SIOAC-DEV WRM JHK THOMAS J. MICHELS CHIEF, SUPPLY ENGINEERING DIV

SUBMITTED WILLIAM F. ERNST CHIEF, LOGISTICS ENGINEERING OFFICE

APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC)

GARY W. ABRISZ
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

TEST CONTAINER
30MM INERT DEPLETED
URANIUM ROUNDS

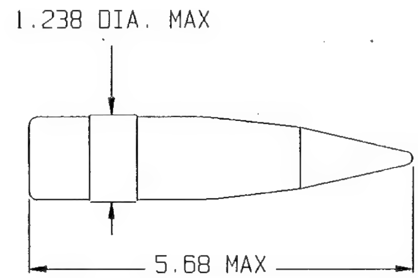
SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 5 OF 8

REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

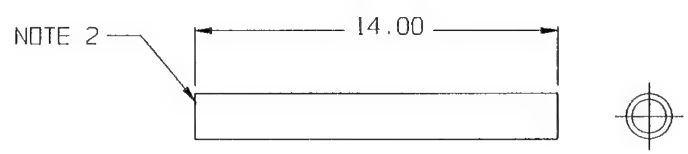
NOTES:

1. PROJECTILE ROUNDS USED IN TEST CONTAINER WERE 3.008 INCH LENGTH. ACTUAL 30MM INERT DEPLETED URANIUM ROUNDS ARE 5.68 INCH. PGM-14 30MM AMMO.

2. RADIATION INSPECTION TUBE 1 INCH NOM SCH. 40 STEEL PIPE WELD ONE SIDE CLOSED



30MM INERT PROJECTILE



RADIATION INSPECTION TUBE

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

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	DFTSMN SKK / CHECKER WM / PROJ ENGR W. MEYER
	SIOAC-DEV WRM JHK THOMAS J. MICHELS CHIEF, SUPPLY ENGINEERING DIV
MATERIAL	SUBMITTED WILLIAM F. ERNST CHIEF, LOGISTICS ENGINEERING OFFICE
	APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC) GARY W. ABRISZ U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
NEXT ASSY / USED ON	
APPLICATION	

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

TEST CONTAINER
30MM INERT DEPLETED
URANIUM ROUNDS

SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 6 OF 8

REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

MATERIALS LIST
(FOR ONE 55 GALLON DEPLETED URANIUM SHIELDED CONTAINER)

(1) 55 GALLON DRUM - UN SPEC. A2/Y1.5/150/91
STEEL, BLACK
NOTE: DRUM TO INCLUDE BARREL RETAINING RING, BARREL LID AND RUBBER GASKET.
Supplier: Skolnick Industries, Inc.
POC Dean Ricker
4900 S. Kilbourn Ave.
Chicago, IL 60632-4593
312-735-0700
or other supplier

(130) LBS. PORTLAND CEMENT - TYPE ONE, manufactured by Essroc, 94 Lbs. bags.
Supplier: Handy Andy Hardware Store or Other Supplier.

(345) LBS. FINE HAMATITE AGGREGATE
Supplier: Nuclear Shielding Supplies and Service
Manjit Chopra
45656 S. Palo Verde, Suite 203
Tucson, AZ 85714
602-748-9362

(6) OZ. SUPER PLASTICIZER- DARACEN 100
Supplier: Mayer Material
RR 1 Bluff Rd.
Channahon, IL 60410
815-467-2236
or other supplier of DARACEN 100

(2) EYE BOLTS-1/2 x 4 THREAD LENGTH
Supplier: Handy Andy Hardware Store or Other Supplier

(2) NUTS - 1/2 Thread (for use with Eye Bolts)
Supplier: See Above

(4) WASHERS - 2 DIAMETER (for use with Eye Bolts)
Supplier: See Above

(283) 30MM INERT PROJECTILES
Supplier: U.S. ARMY

(52) LBS. Approx. WATER

(1) 10 DIA. "SONO TUBE"- 3/16 THICK FIBER FORM
CUT TO 23 LENGTH.
OR EQUIVALENT CONCRETE FORM SUPPORT.
Supplier: McCann Construction Specialities Co.
303 Republic Ave.
Joliet, IL 60435-6519
815-744-5511
or other supplier

(1) 16 DIA. "SONO TUBE"- 1/4 THICK FIBER FORM
CUT TO 28 LENGTH.
OR EQUIVALENT CONCRETE FORM SUPPORT.
Supplier: See Above

(143) LBS. SAND- coarse, all purpose, Torpedo brand, in 50 LBS. bags.
Supplier: Smith Brother Garden Center
2601 E. Lincoln Highway
New Lenox, IL 60451
815-485-9420
or other supplier

(260) LBS. COARSE AGGREGATE - 5/8 DIAMETER
Metanec stone (small)
Supplier: See Above or other supplier

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

PART NO ACV00282-7

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NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. BREAK SHARP CORNERS AND EDGES.
TOLERANCES ON
FRACTIONS ± 1/8
DECIMALS ±
MATERIAL

DATE 96-01-17
DFTSMN SKK | CHECKER WM | PROJ ENGR W. MEYER
SIOAC-DEV WRM UHK | THOMAS J. MICHELS, CHIEF, SUPPLY ENGINEERING DIV
SUBMITTED WILLIAM F. ERNST, CHIEF, LOGISTICS ENGINEERING OFFICE
APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC)
GARY W. ABRISZ
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

TEST CONTAINER
30MM INERT DEPLETED
URANIUM ROUNDS

SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 7 OF 8

REVISION			
LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE	96-05-06	W.R. MEYER
A	ADMINISTRATIVE CHANGES	96-05-20	

CONCRETE MIXTURE

(FOR ONE BATCH OF HIGH DENSITY CONCRETE)

INGREDIENTS	WEIGHT
PORTLAND CEMENT	10 LBS
WATER	6 LBS
COARSE AGGREGATE (5/8" DIAMETER)	20 LBS
SAND	11 LBS
FINE HEMATITE	26.5 LBS
SUPER PLASTICIZER	0.5 OZ

THE BATCH CAN BE ANY SIZE, AS LONG AS THE INGREDIENTS ARE A MULTIPLE OF THE ABOVE.

THE DRAWING DEPICTS THE ITEMS AS TESTED AND ARE NOT TO BE USED FOR PRODUCTION PURPOSES. THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL (USADACS) AND THE U.S. GOVERNMENT ASSUME NO LIABILITY.

PART NO ACV00282-8

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NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. BREAK SHARP CORNERS AND EDGES.
TOLERANCES ON
FRACTIONS ± 1/8
DECIMALS ±

MATERIAL

DATE 96-01-19

DFTSMN	CHECKER	PROJ ENGR
SKK	WM	W. MEYER

SIDAC-DEV WRM JHK THOMAS J. MICHELS CHIEF, SUPPLY ENGINEERING DIV

SUBMITTED WILLIAM F. ERNST CHIEF, LOGISTICS ENGINEERING OFFICE

APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC)
GARY W. ABRISZ
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

DESIGN ACTIVITY
U.S. ARMY
INDUSTRIAL OPERATIONS COMMAND
DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

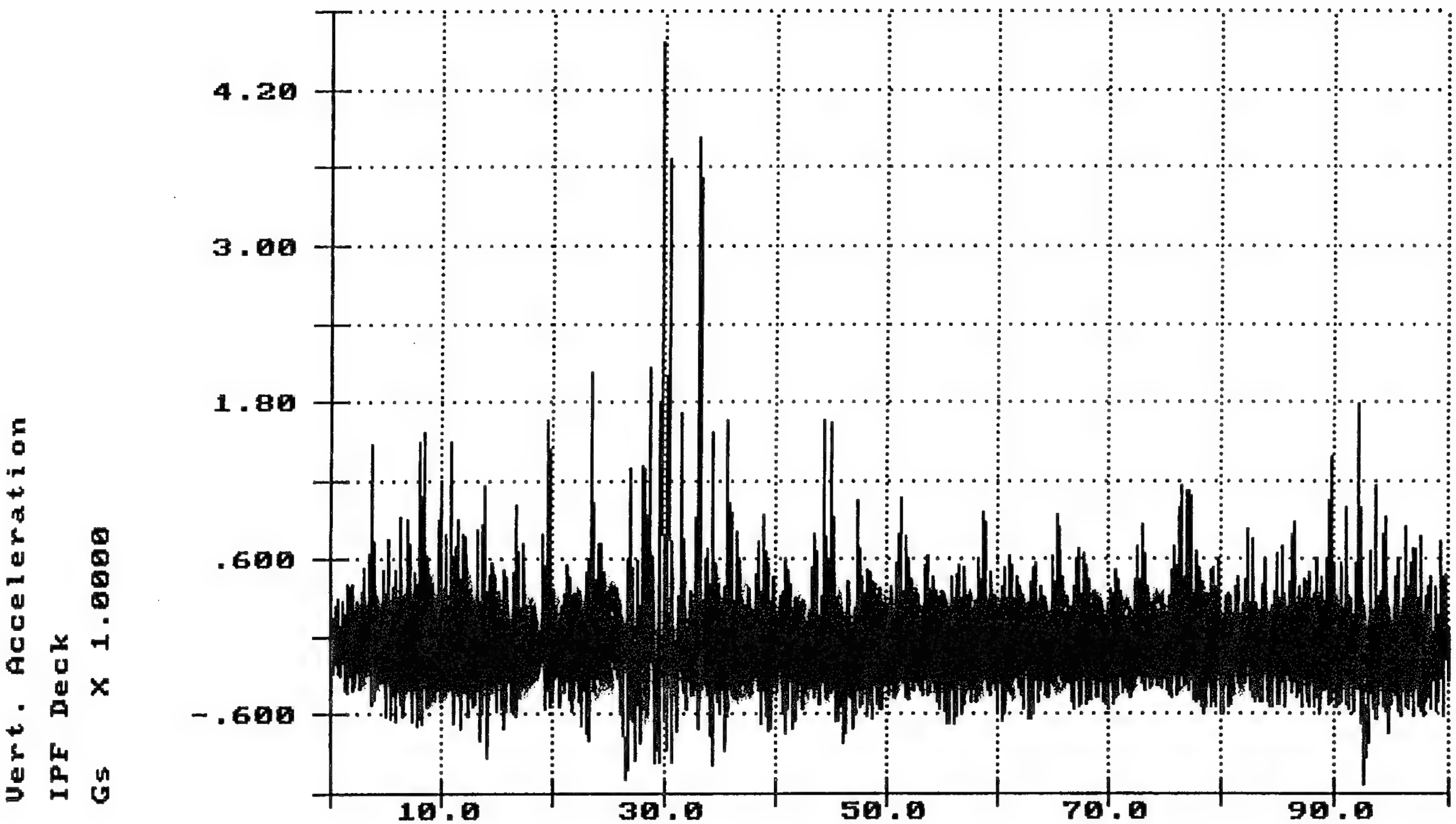
TEST CONTAINER
30MM INERT DEPLETED
URANIUM ROUNDS

SIZE	CAGE CODE	
C	28620	ACV00282
SCALE NONE	UNIT WT	SHEET 8 OF 8

PART 7

GRAPHS

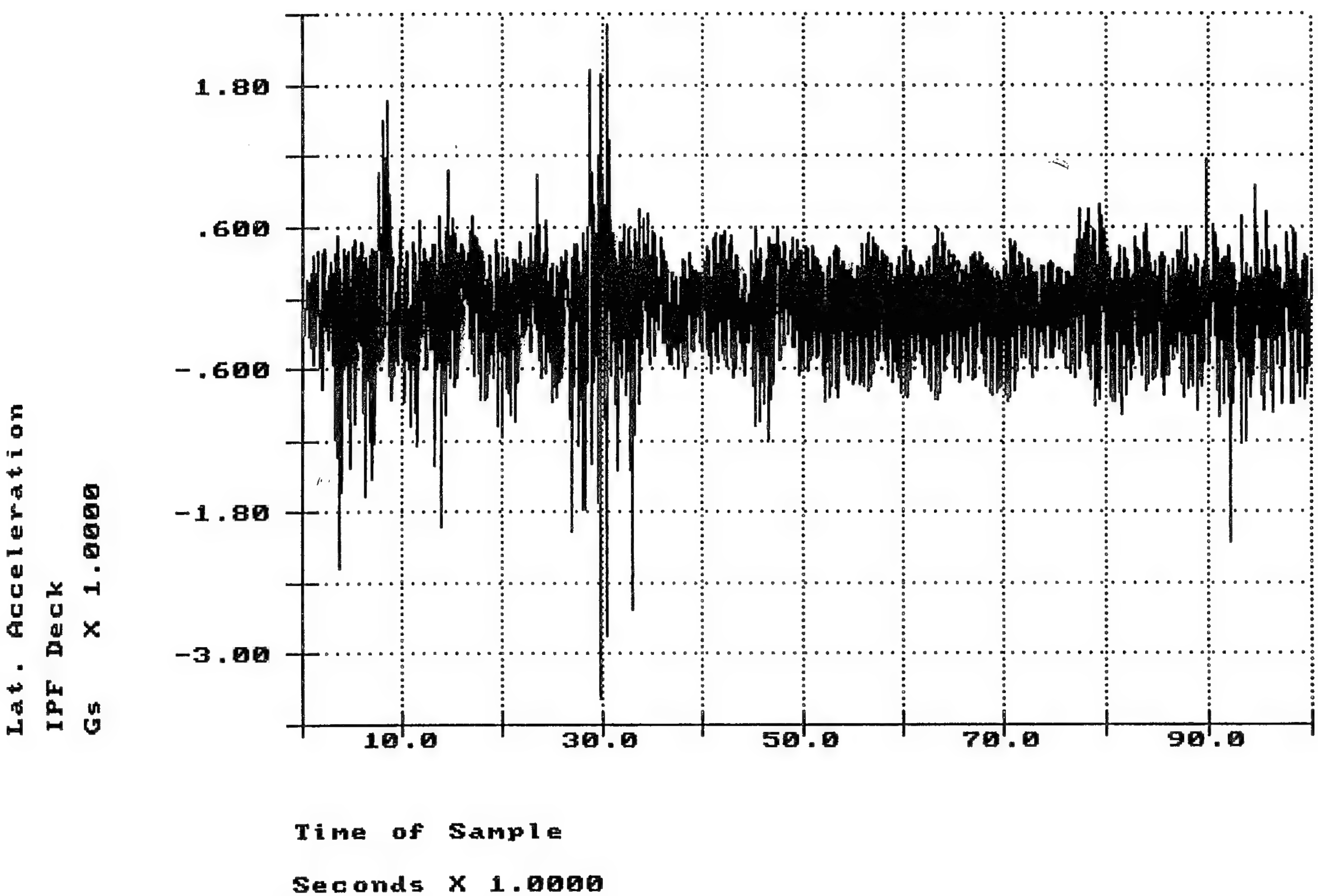
Vibration test of Nuc Drum   Aug 01 12:47:39 1995



Time of Sample

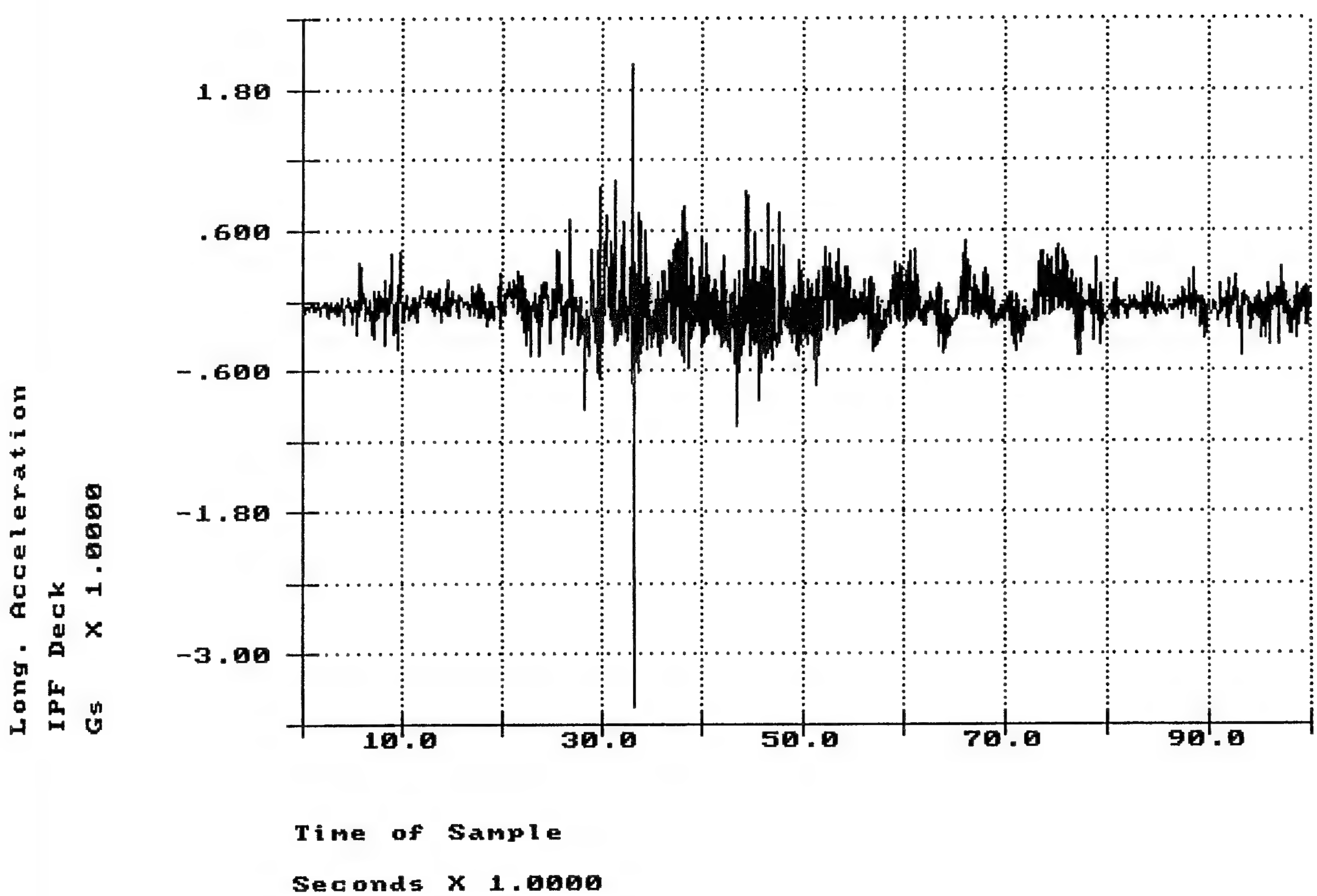
Seconds X 1.0000

Vibration test of Nuc Drum Aug 01 12:47:39 1995



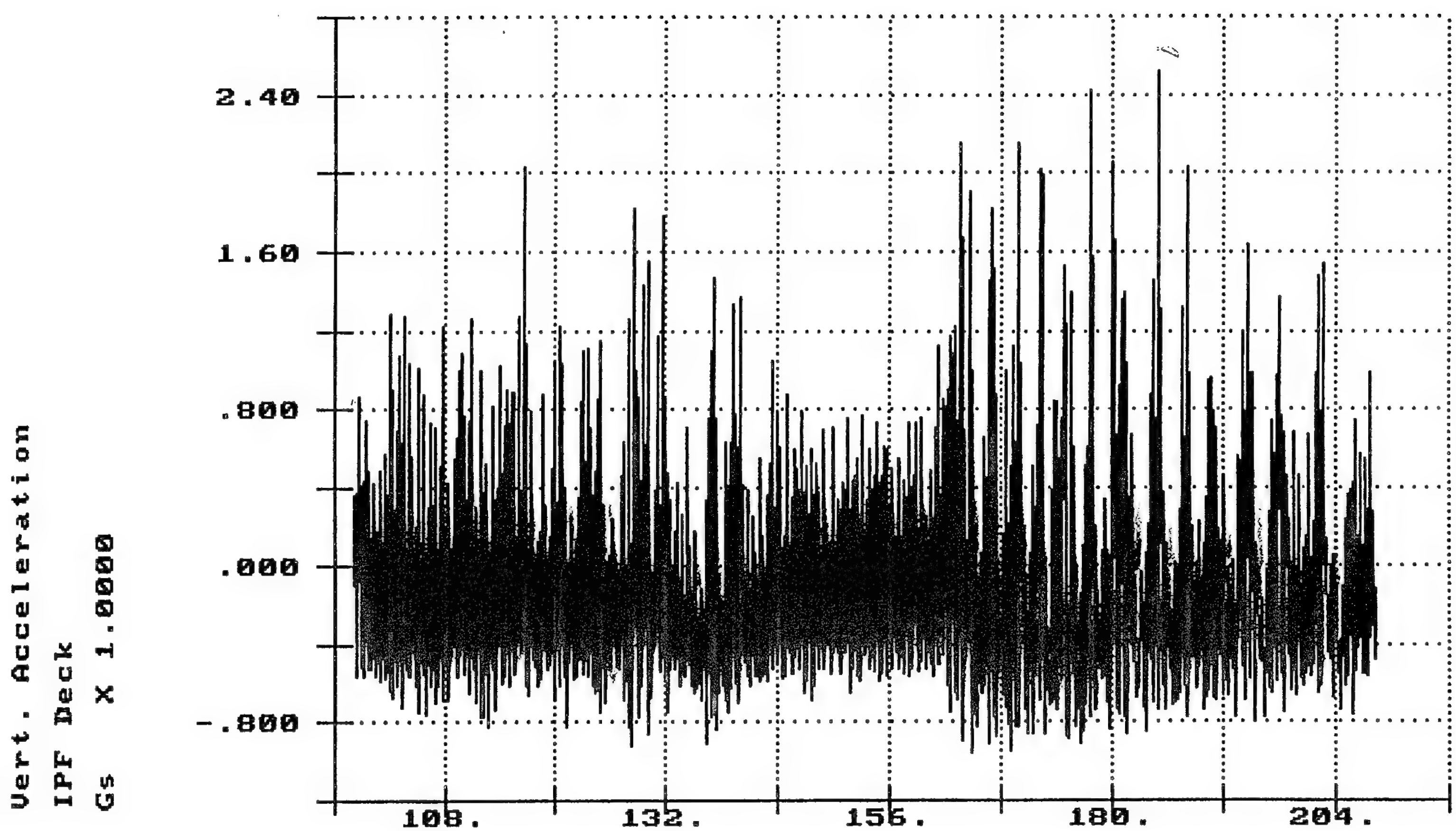
Vibration test of Nuc Drum

Aug 01 12:47:39 1995



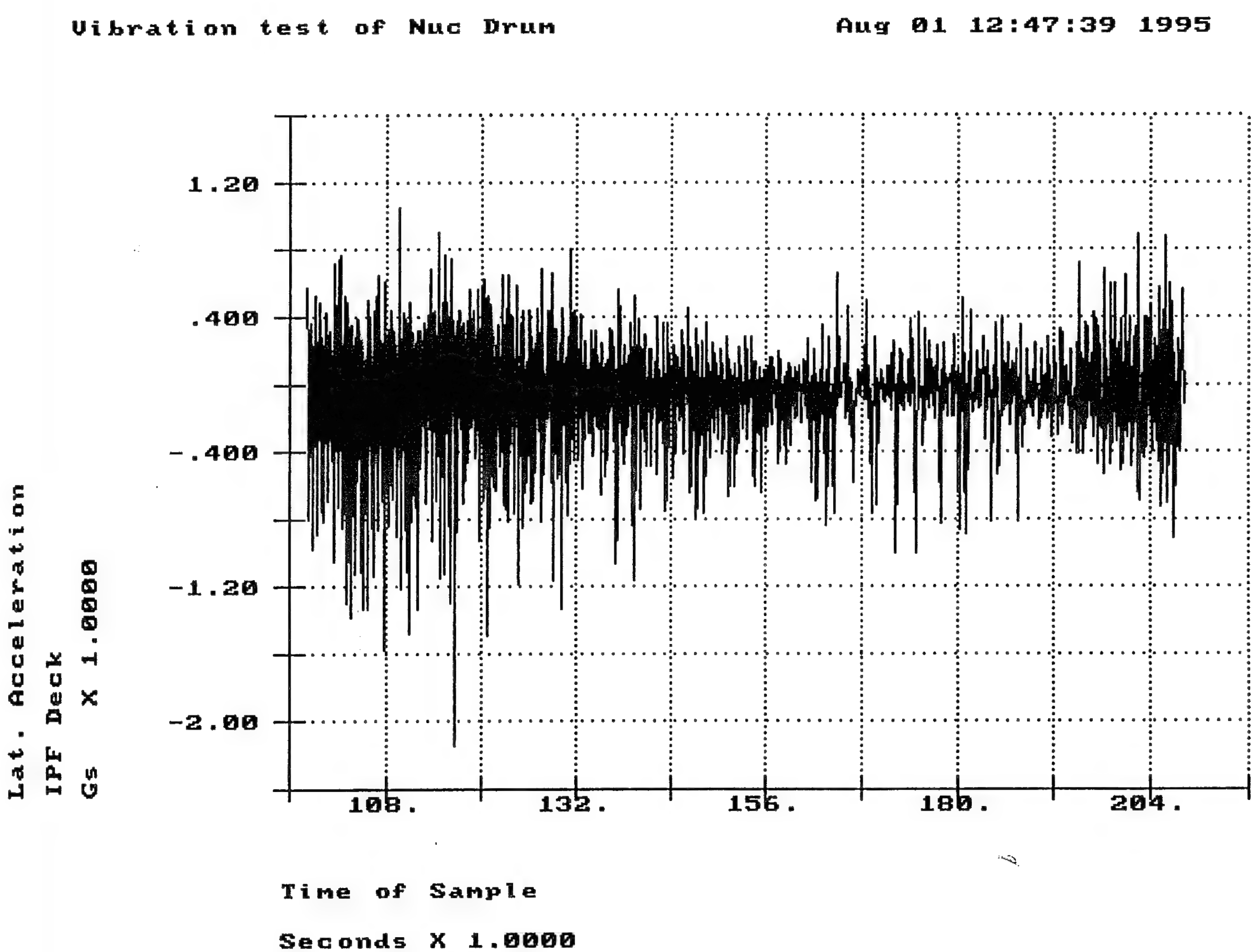
Vibration test of Nuc Drum

Aug 01 12:47:39 1995



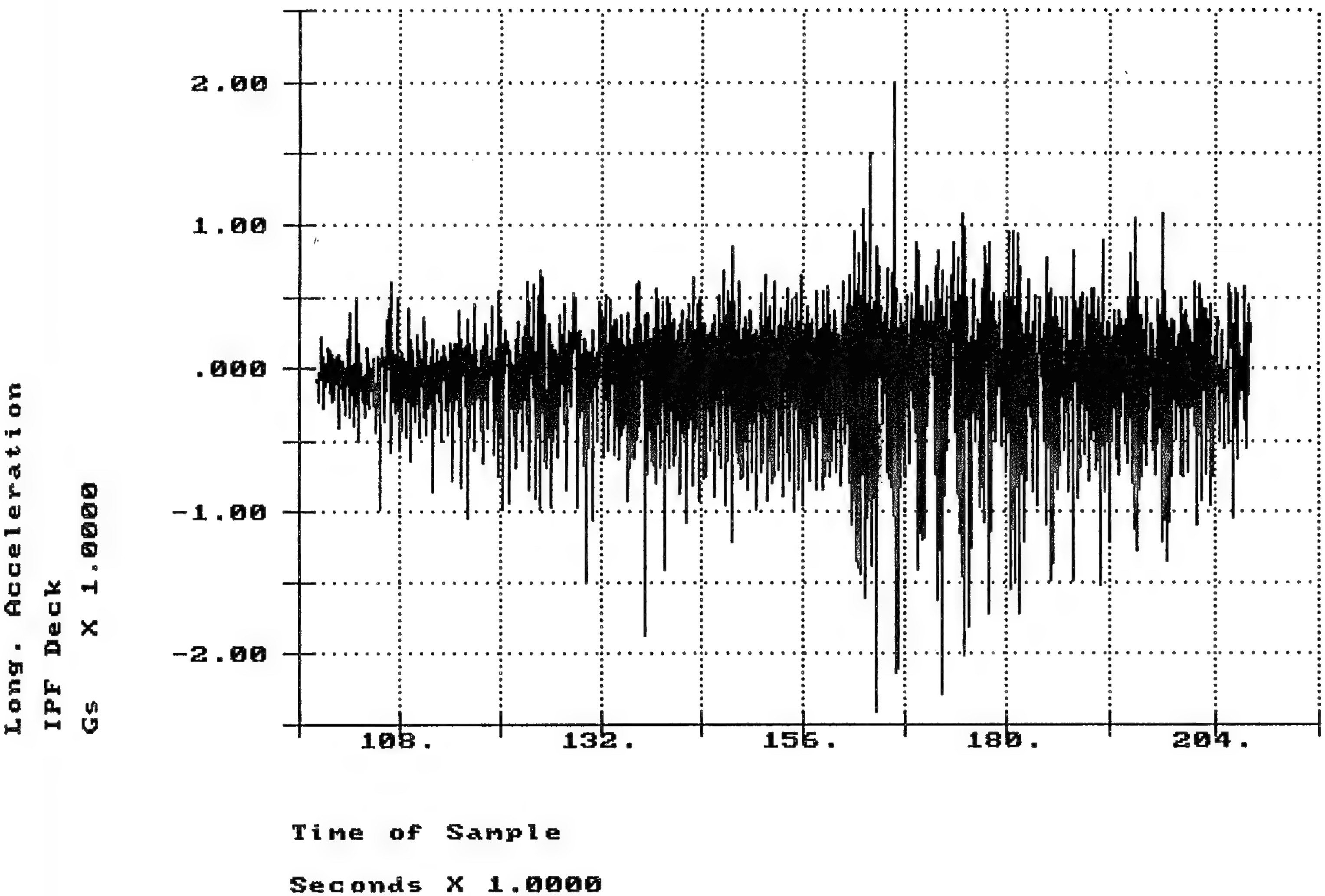
Time of Sample

Seconds X 1.0000



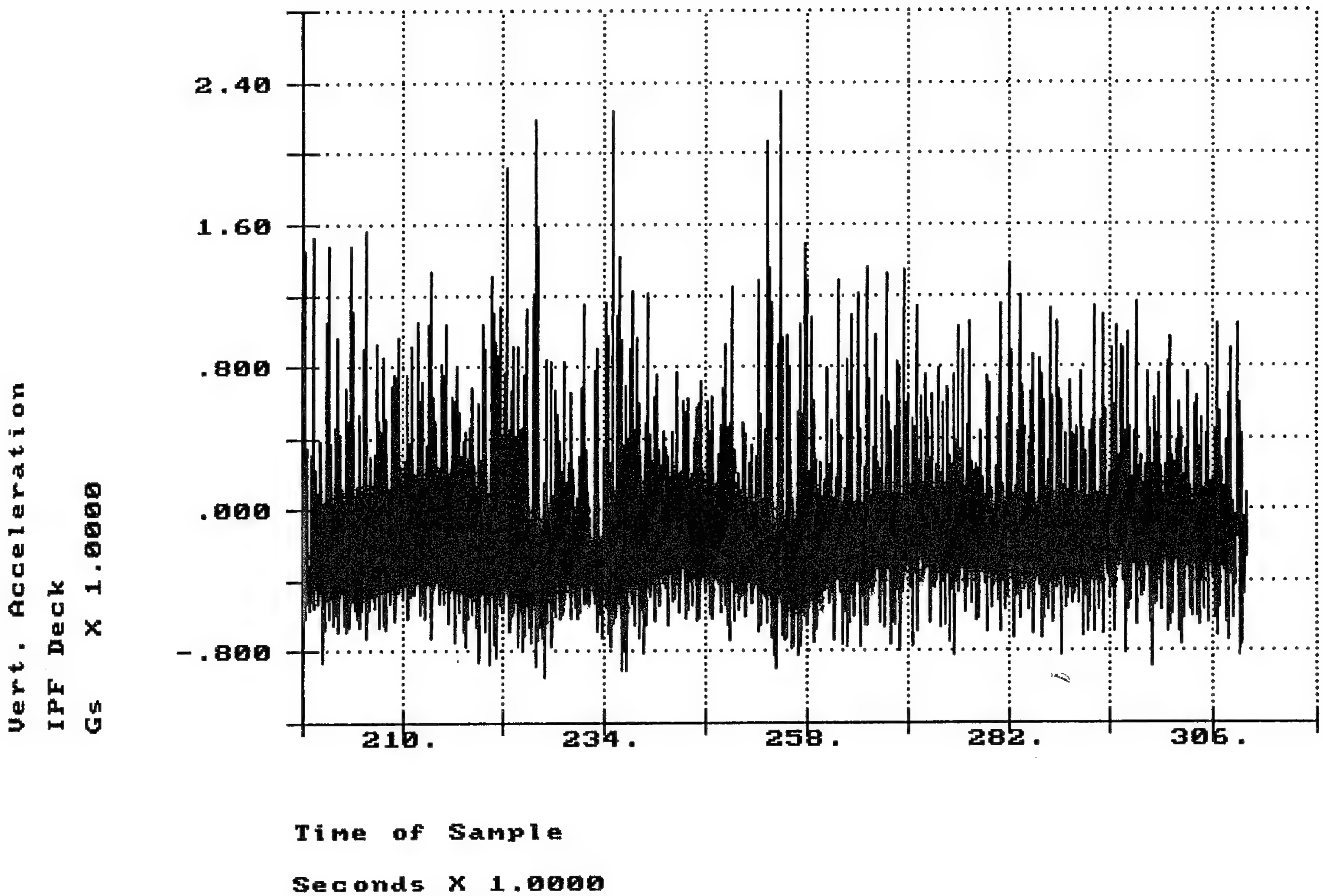
Vibration test of Nuc Drum
Aug 01 12:47:39 1995
1.20
.400
-.400
-1.20
-2.00
108.
132.
156.
180.
204.
Lat. Acceleration
IPF Deck
Gs X 1.0000
Time of Sample
Seconds X 1.0000

Vibration test of Nuc Drum Aug 01 12:47:39 1995



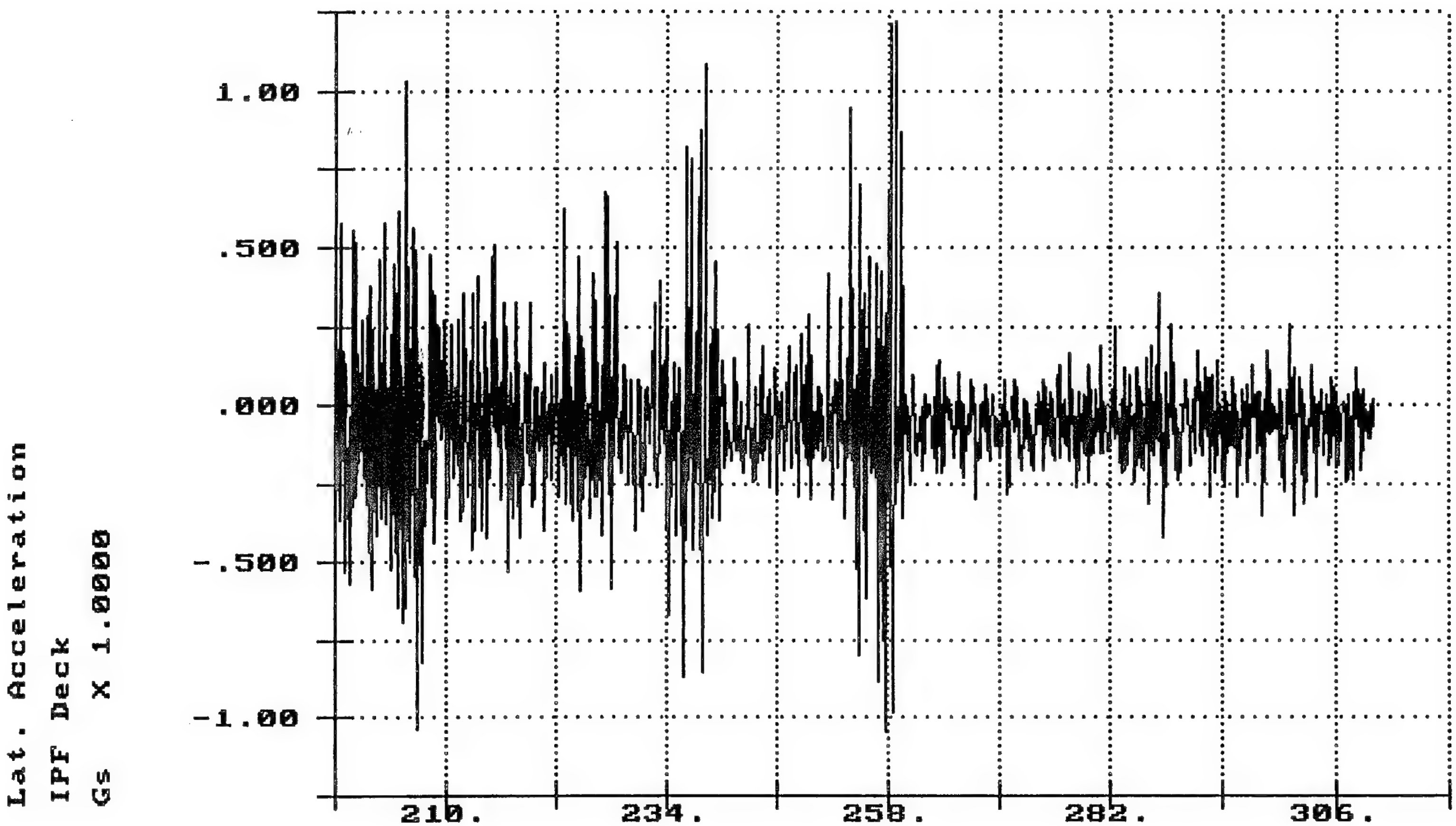
Vibration test of Nuc Drum

Aug 01 12:47:39 1995



Vibration test of Nuc Drum

Aug 01 12:47:39 1995

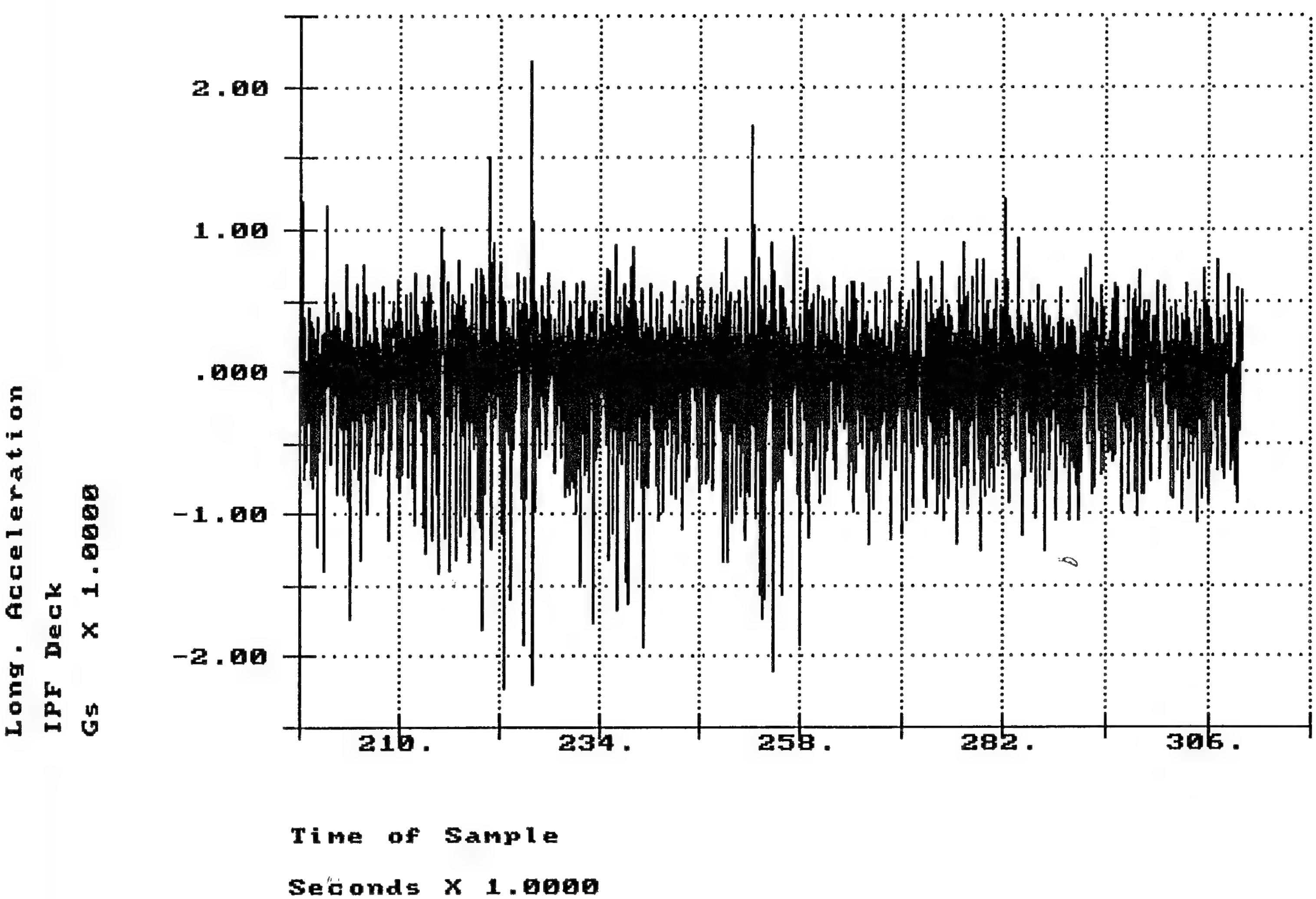


Time of Sample

Seconds X 1.0000

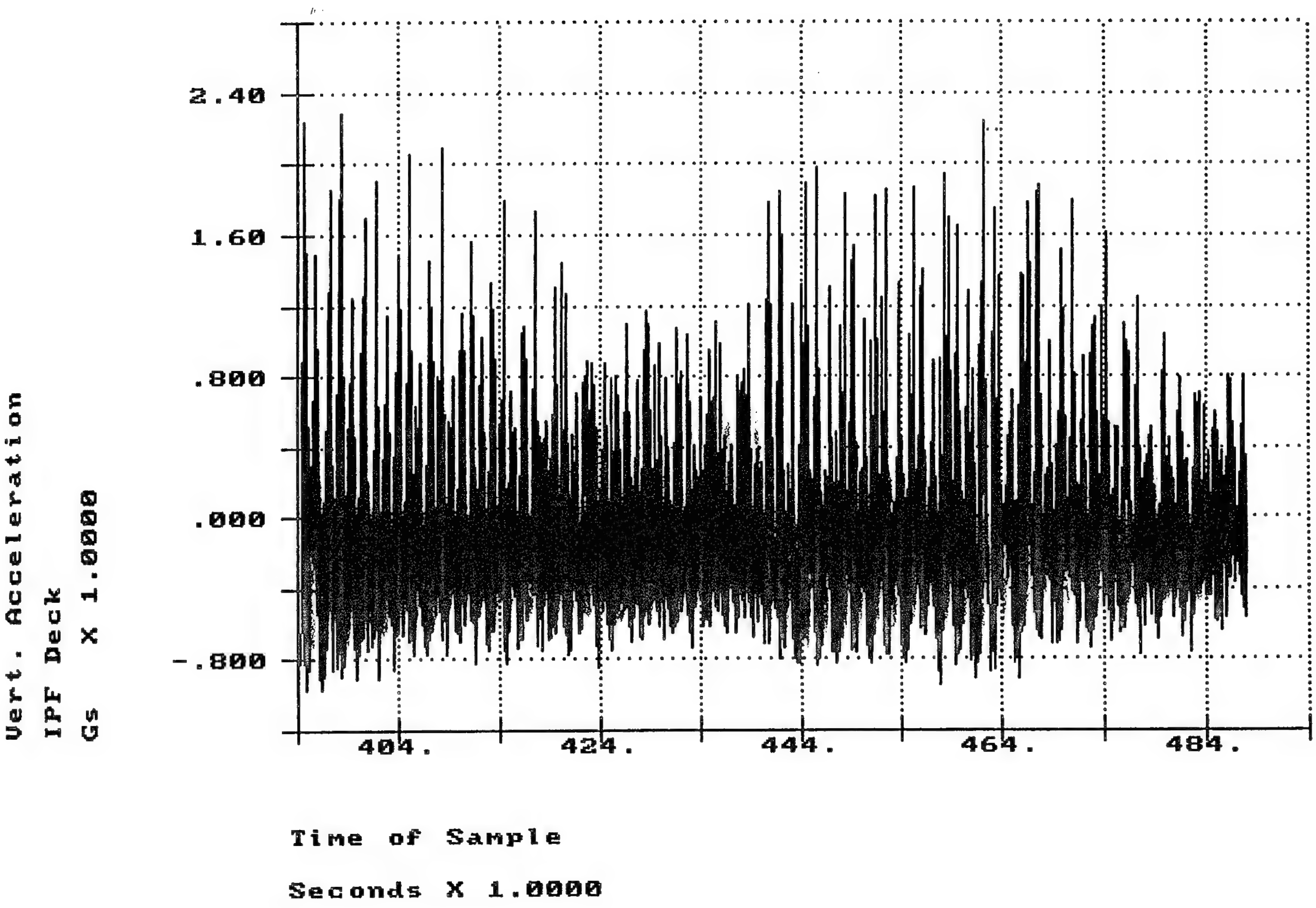
Vibration test of Nuc Drum

Aug 01 12:47:39 1995



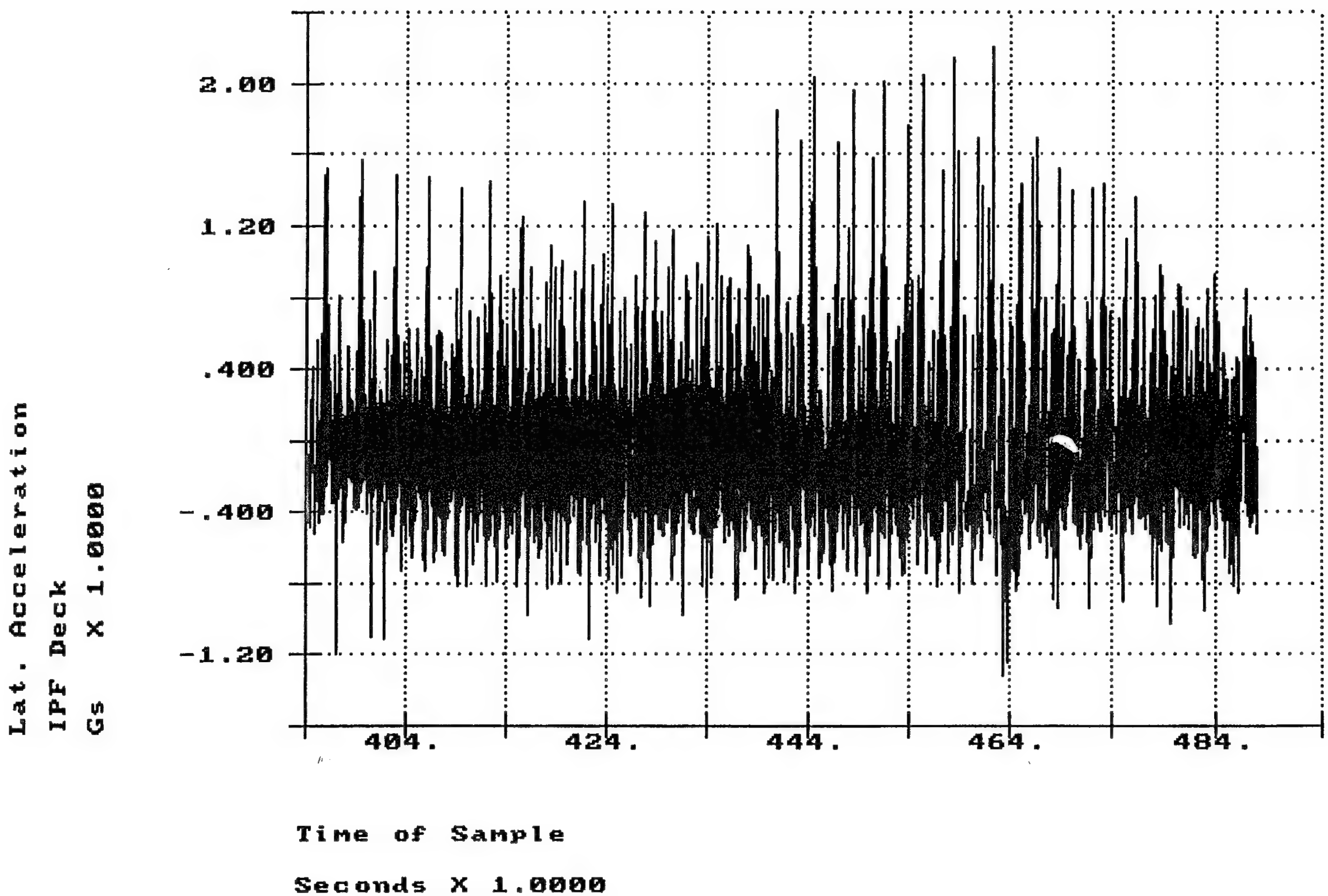
Vibration test of Nuc Drum

Aug 01 12:47:39 1995



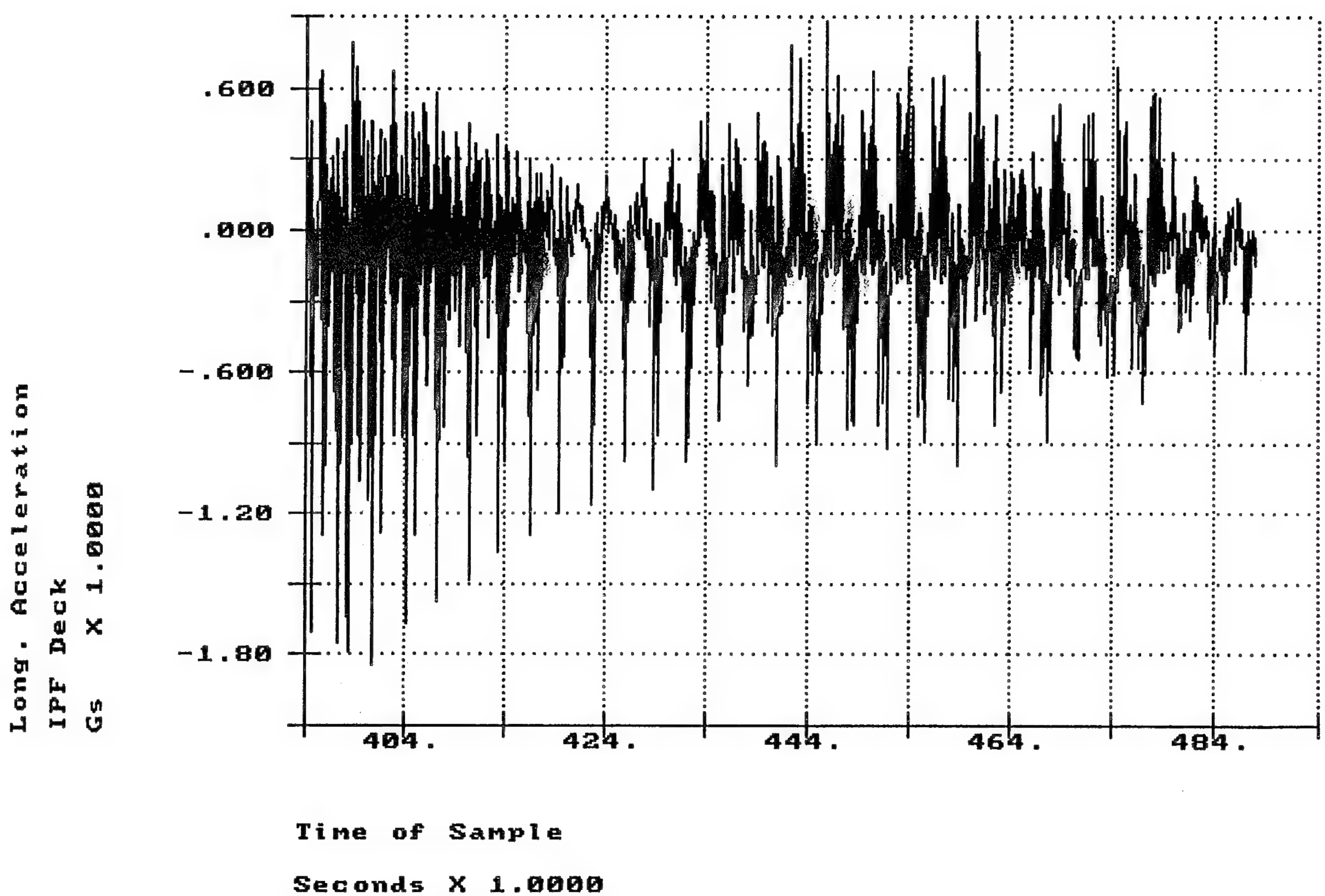
Vibration test of Nuc Drum

Aug 01 12:47:39 1995



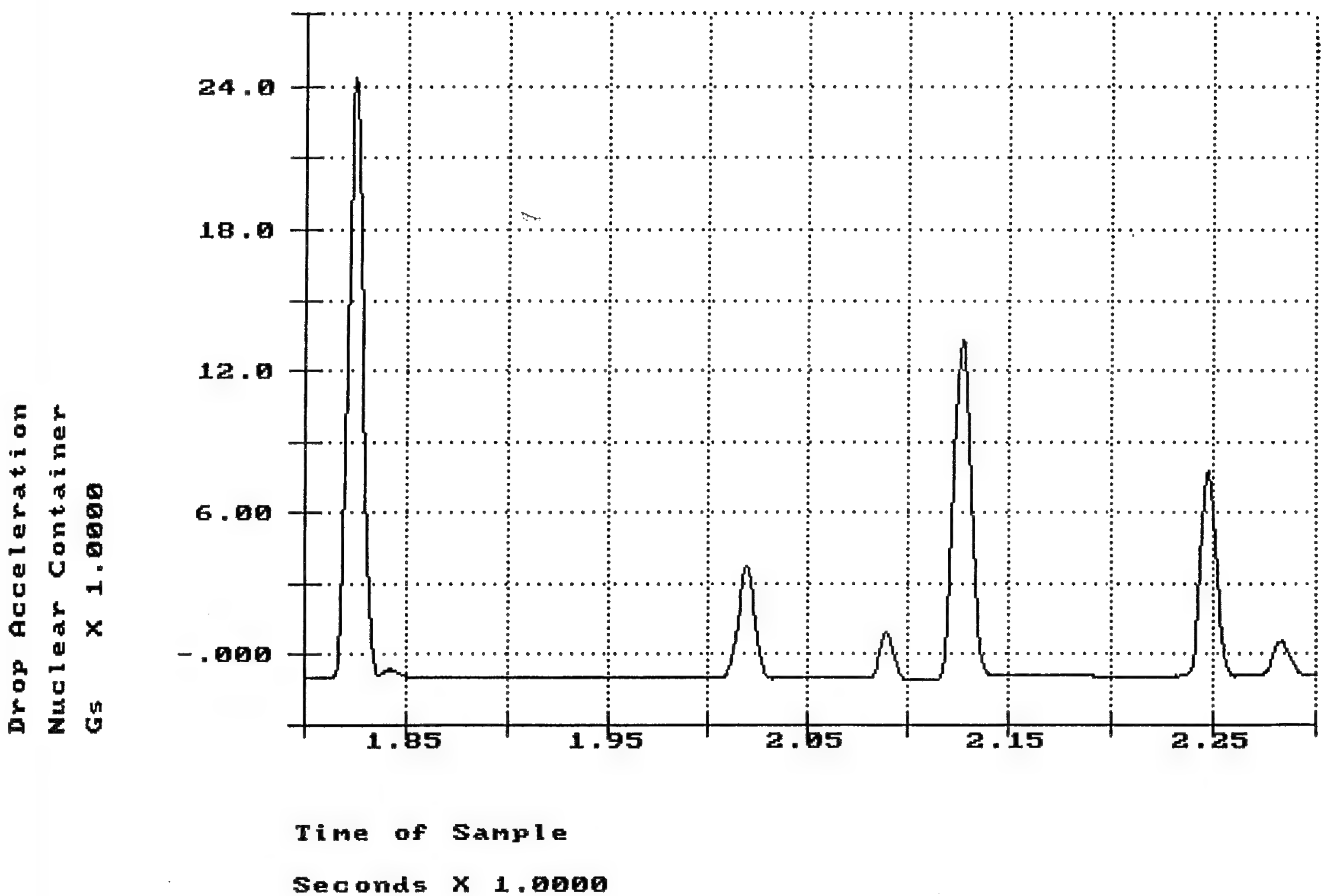
Vibration test of Nuc Drum

Aug 01 12:47:39 1995

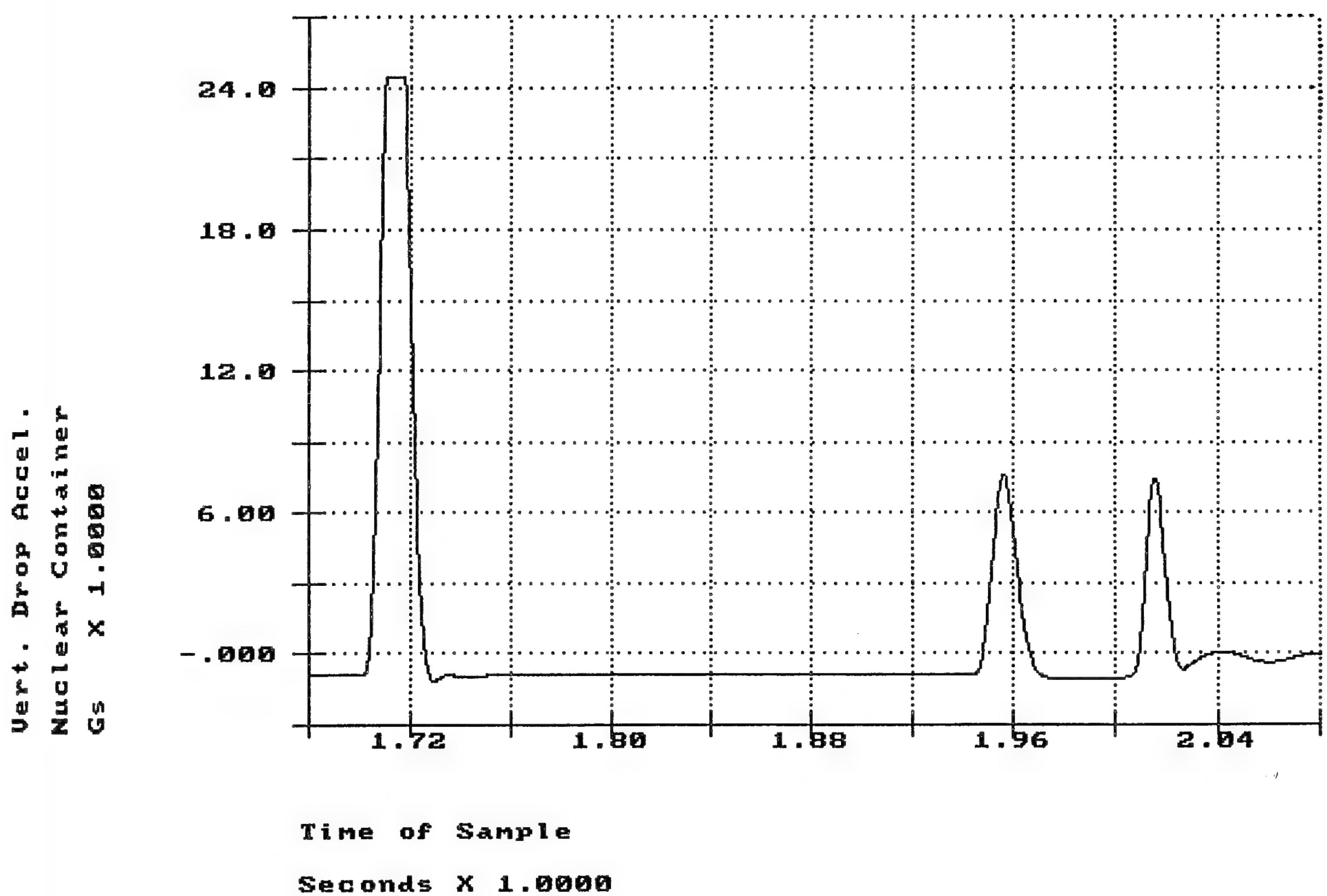


Side drop of Nuc Drum

Aug 02 13:14:25 1995

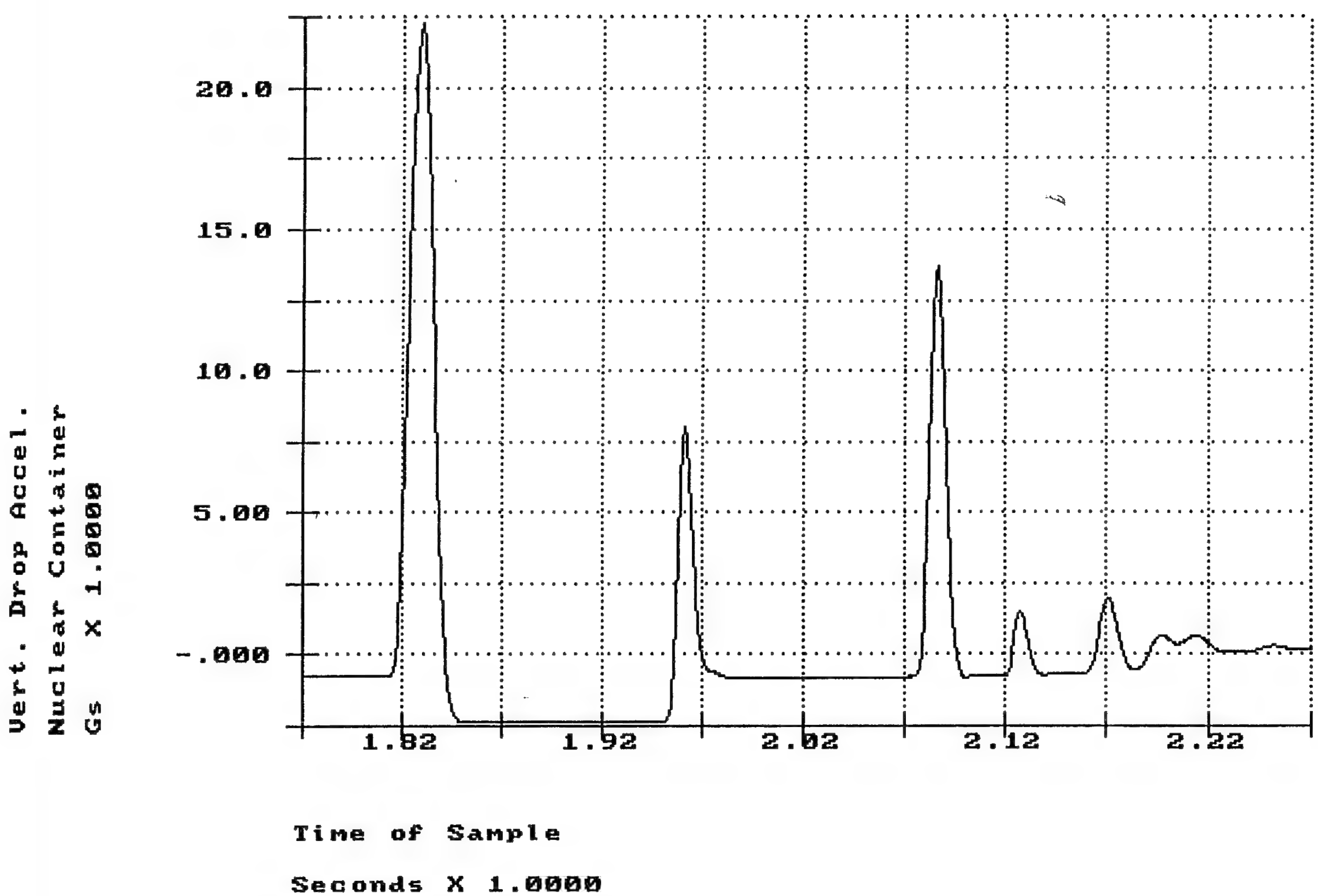


End drop of Nuc Drum Aug 02 14:42:25 1995



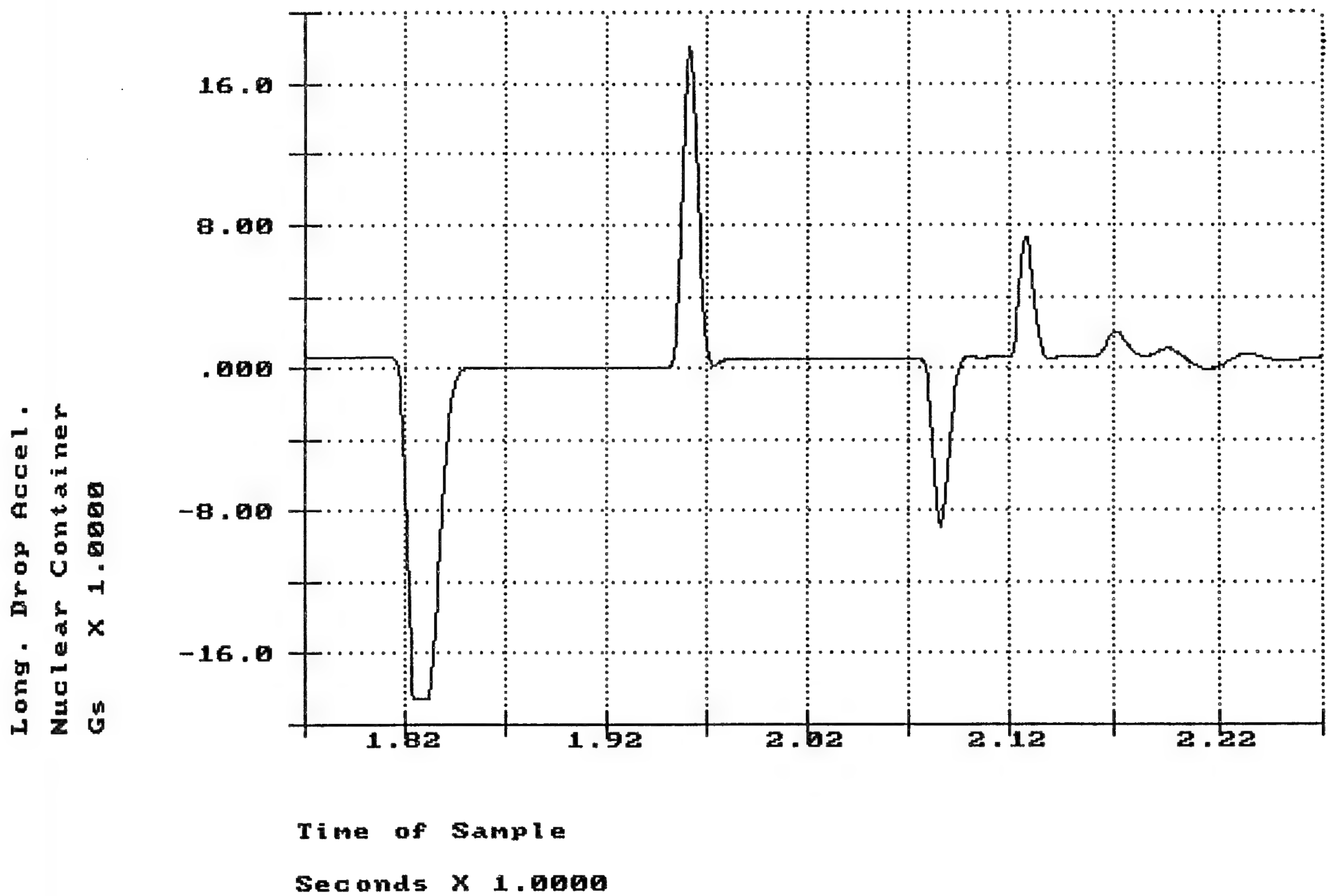
Angled drop of Nuc Drum

Aug 02 13:58:46 1995



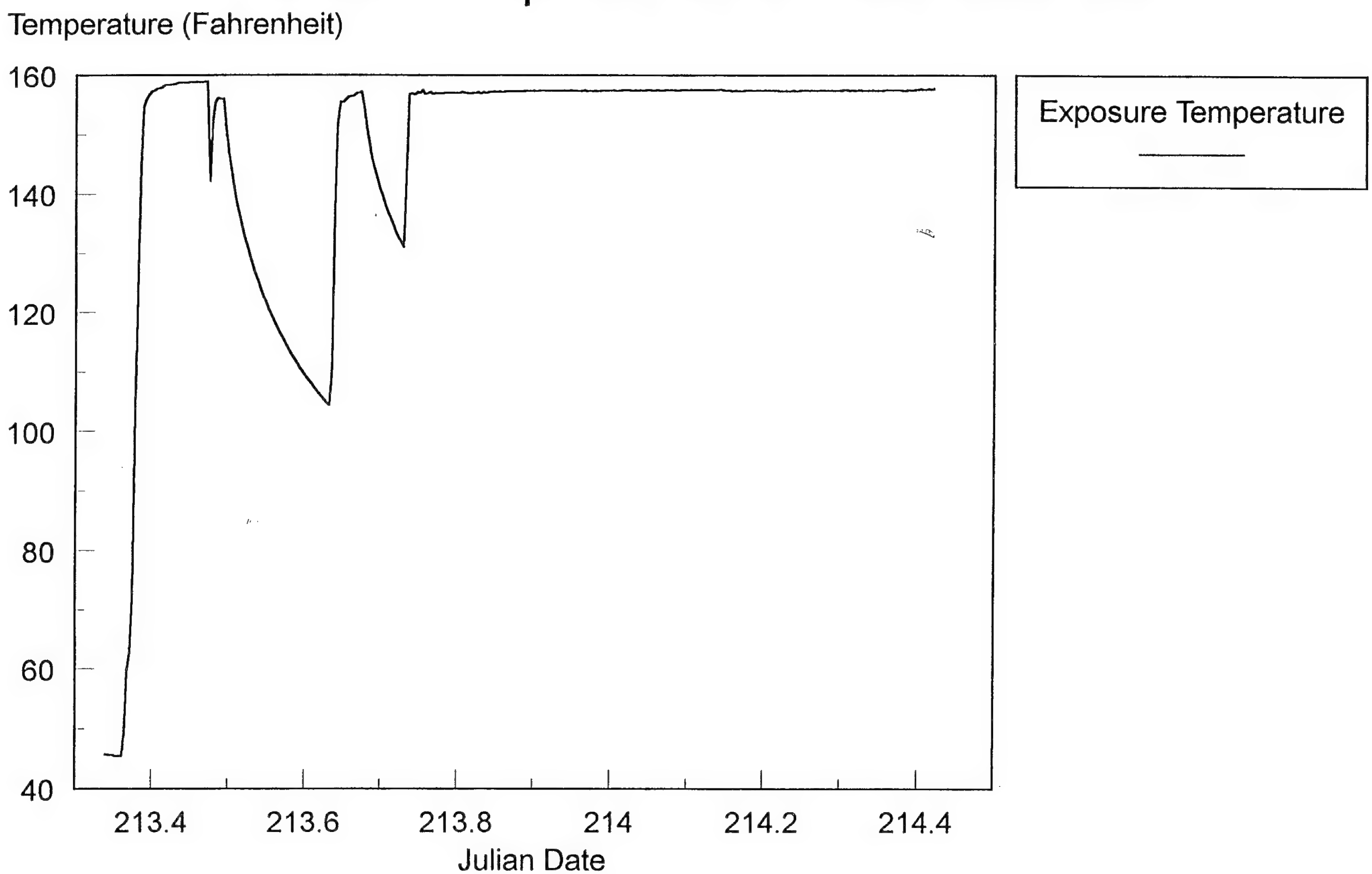
Angled drop of Nuc Drum

Aug 02 13:58:46 1995



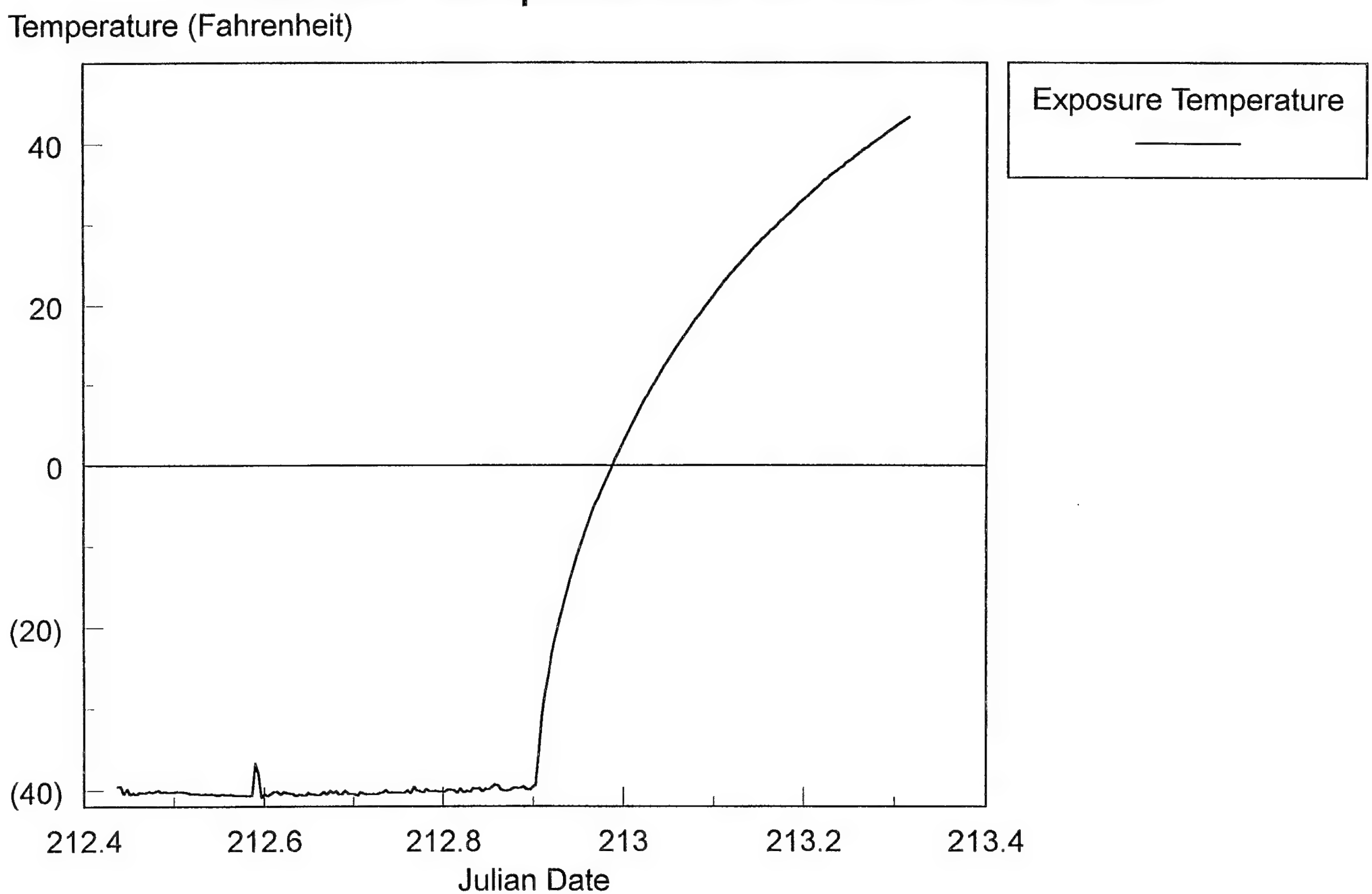
55 Gallon Depleted Uranium Shielded Container

Chamber Temperatures for Heat Soak Test



55 Gallon Depleted Uranium Container

Chamber Temperatures for Cold Soak Test



PART 8

RADIOGRAPHIC SURVEYS

X-R-I TESTING

DIVISION OF X-RAY INDUSTRIES, INC.

Test 1

Type

Yellow Drum
MR/HR @Contact With Drum

Initial Reading	After Cold	After Heat 4@12:00	After Heat 3@12:00	After Side Drop 1@12:00	After Side Drop 4@12:00	After Lid Drop 3@12:00	After Lid Drop 4@12:00
3.5	3.5	4	5	3	3.5	4	2.5
7.5	5.5	5	5.5	4.5	6	4.5	4
5.0	6	5.5	5	5.5	5	4.5	3.5
2.5	4	3.5	4	4	3	4	3
17.5	14.5	16	17	17	14	-	12
75.0	70	65	70	75	60	-	50
11	10	10.5	10	12	9	-	8
35	40	35	36	32	-	35	-
225	300	350	350	260	-	300 *	-
30	35	25	32	25	-	25	-
80	80	80	85	-	70	70	60
750	750	850	750	-	700	750	550
50	45	53	62	-	55	60	35
20	25	26	22	20	25	20	20
140	150	250	200	125	250	200	130
16	19	20	17	15	20	15	15
1.5	2.0	1.7	1.5	1	1.5	1	1
2.5	3	3.7	2.5	2	2	2	1
3.0	2.5	3.5	2.0	2	2	2	1
1.0	0.5	1.5	1.5	1	1	2	1
3.0	3	5	3.5	3.5	2.5	2	1

* GREATER THAN 20% ↑

OAK LAWN LABORATORY • 4585 Southwest Hwy. • Oak Lawn, IL 60453 • (708) 424-0991 • Fax (708) 424-0290
CORPORATE OFFICE: • Troy, MI 48084 • (810) 362-2242

X-R-I TESTING
DIVISION OF X-RAY INDUSTRIES, INC.

Test 1

Red Drum
MR/HR @Contact With Drum

IN	After Compress	After Vibrate		#3 @10:00	#1 @12:00	#2 @12:00	After 3rd Vibration #19 @12:00	After 3rd Vibration #20 @12:00	After Corner Drop 4 @12:00	After Corner Drop 3 @12:00 *
2.5	2	2	3	3	2.5	2.6	2.5		3	4 *
2.0	4	2	3.5	4.5	3.0	3.3	2.5		3	3.5 *
2.0	4.5	3	3.5	5.5	4.5	4	4		3.5	4.5
2.5	3.5	2.5	2.5	4	3.5	4	3		2.5	3
20	20	21	17	17	25	15	18	25	15	-
250	250	250	200	75	250	200	125	200	125	-
15	14	16	15	12	15	15	16	15	15	-
30	35	40	35	32	37	35	40	32	-	22
400	350	450	400	260	400	450	425	350	-	350
30	25	35	30	25	25	35	30	22	-	24
30	37	40	45	-	43	45	39		40	55 *
450	410	400	440	-	450	450	400		400	500
35	28	30	32	-	32	30	25		25	30
25	25	20	20	20	20	20	22		30	20
250	250	250	240	125	200	250	250		300	225
25	25	21	22	15	20	16	15		20	15
2.5	2.5	2.5	1	1	2.5	2.5	2.5		1.5	1
3	3.0	3.5	2	2	1.5	2.7	2.5		1.5	1
2.5	2.5	2	2.5	2	1.5	2.3	1.5		2.0	1.5
3.5	2.5	3	2.5	1	1.5	2.0	1.5		1.5	2.0
4.5	3.5	5	3.5	3.5	3.5	3.5	3		2	2

* GREATER THAN 20% ↑

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CONAM

BLUE NUCLEAR CONTAINER
DECEMBER 1995

	Before Test Control #1 12/12/95	Control #2 12/12/95	Post Compression Test 12/13/95	Post Vibration Test 12/14/95	Post Drop Test (Vertical) 12/14/95	
Location	**Reading 1**	**Reading 2**	**Reading 3**	**Reading 4**	**Reading 5**	**Reading 6**
1	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
2	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
3	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
4	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
5	5 mR	5 mR	5 mR	5 mR	5 mR	
6	40 mR	40 mR	40 mR	40 mR	40 mR	
7	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
8	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
9	40 mR	40 mR	38 mR	38 mR	40 mR	
10	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
11	5 mR	5 mR	< 5mR	< 5mR	< 5mR	
12	50 mR	50 mR	50 mR	50 mR	50 mR	
13	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
14	5 mR	5 mR	< 5mR	< 5mR	5 mR	
15	50 mR	50 mR	48 mR	49 mR	49 mR	
16	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
17	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
18	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
19	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	
20	< 5mR	< 5mR	< 5mR	< 5mR	< 5mR	

CONAM

YELLOW NUCLEAR CONTAINER
DECEMBER 1995

	Before Test Control #1 12/12/95	Post Heat Test 12/13/95	Post Vibration Test 12/14/95	Post Drop Test (Horizontal) 12/14/95		
Location	Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Reading 6
1	< 5mR	< 5mR	< 5mR	< 5mR		
2	< 5mR	< 5mR	< 5mR	< 5mR		
3	< 5mR	< 5mR	< 5mR	< 5mR		
4	< 5mR	< 5mR	< 5mR	< 5mR		
5	5 mR	5 mR	5 mR	5 mR		
6	57 mR	55 mR	55 mR	55 mR		
7	< 5mR	< 5mR	< 5mR	< 5mR		
8	5mR	5mR	5mR	5mR		
9	50 mR	50 mR	50 mR	50 mR		
10	< 5mR	< 5mR	< 5mR	< 5mR		
11	< 5 mR	< 5 mR	< 5mR	< 5mR		
12	39 mR	39 mR	35 mR	38 mR		
13	< 5mR	< 5mR	< 5mR	< 5mR		
14	5 mR	5 mR	< 5mR	< 5mR		
15	40 mR	40 mR	39 mR	40 mR		
16	< 5mR	< 5mR	< 5mR	< 5mR		
17	< 5mR	< 5mR	< 5mR	< 5mR		
18	< 5mR	< 5mR	< 5mR	< 5mR		
19	< 5mR	< 5mR	< 5mR	< 5mR		
20	< 5mR	< 5mR	< 5mR	< 5mR		

CONAM

RED NUCLEAR CONTAINER
DECEMBER 1995

	Before Test Control #1 12/12/95	Post Cold Test 12/13/95	Post Vibration Test 12/14/95	Post Drop Test (Angle) 12/14/95		
Location	**Reading 1**	**Reading 2**	**Reading 3**	**Reading 4**	**Reading 5**	**Reading 6**
1	< 5mR	< 5mR	< 5mR	< 5mR		
2	< 5mR	< 5mR	< 5mR	< 5mR		
3	< 5mR	< 5mR	< 5mR	< 5mR		
4	< 5mR	< 5mR	< 5mR	< 5mR		
5	5 mR	5 mR	5 mR	5 mR		
6	42 mR	40 mR	45 mR	44 mR		
7	< 5mR	< 5mR	< 5mR	< 5mR		
8	5mR	5mR	5mR	5mR		
9	48 mR	48 mR	45 mR	49 mR		
10	< 5mR	< 5mR	< 5mR	< 5mR		
11	5 mR	5 mR	< 5mR	< 5mR		
12	49 mR	48 mR	48 mR	48 mR		
13	< 5mR	< 5mR	< 5mR	< 5mR		
14	5 mR	5 mR	< 5mR	5mR		
15	50 mR	49 mR	49 mR	50 mR		
16	< 5mR	< 5mR	< 5mR	< 5mR		
17	< 5mR	< 5mR	< 5mR	< 5mR		
18	< 5mR	< 5mR	< 5mR	< 5mR		
19	< 5mR	< 5mR	< 5mR	< 5mR		
20	< 5mR	< 5mR	< 5mR	< 5mR		

PART 9

APPENDIX

CUSTOMER: CONAM INSPECTION INC

CAL1

NDS PRODUCTS, INC

P.O.BOX 1896
PASADENA TEXAS 77501
PHONE: (713) 475-2986

CALIBRATION CERTIFICATE
TEXAS LICENSE # L00991

111 ANDERSON
PASADENA TEXAS 77506
FAX: (713) 477-6741

INSTRUMENT OWNER: CONAM INSPECTION INC
1245 W NORWOOD AVE
ITASCA IL 60143

ORDER NR.: 52961
MFG: NDS PRODUCTS INC
MODEL: ND-200P
SERIAL NR.: 19122

CALIBRATION DATE: 06-DEC-1995 CALIBRATION DUE DATE: 06-MAR-1996

T. 70DEG. F. R.H. 59 % B.P 762.53 mm Hg

Y:HIGH & LOW VOLTAGES CHECKED
Y:CURRENT DRAIN CHECKED
Y:SATURATION > 15 R/hr
:INSPECTED FOR DAMAGE
Y:TIGHTENED LOOSE HARDWARE

Y:BATTERIES CHECKED
Y:REPLACED WITH: EN95
Y:METER ZEROED Y:GEOTROPISM CHECKED
:PROBE MODEL & S/N: EW101-01 10005
Y:PROPER FUNCTIONING ASSURED

PARTS REPLACED:

COMMENTS: CALIBRATED WITH DETECTOR WINDOW FACING SOURCE

NDS PRODUCTS CERTIFIES THAT THE ABOVE INSTRUMENT HAS BEEN CALIBRATED BY STANDARDS TRACEABLE TO N.I.S.T.. THE CALIBRATION SYSTEM CONFORMS TO THE REQUIREMENTS OF MIL-STD-45662, ANSI-N323-1978, N.R.C. 10 CFR PART 34.24, 10CFR 39.33, TEXAS TRCR PART 46.5, PART 31.5, AND PART 36.13. NEW MEXICO REG. NO. 271-3. ARKANSAS REG. NO. VS0386.

CALIBRATED TO Cs-137 0.662 MeV S/N 310, NIST TEST NO. DG8953/89, DG8639/87 AND DG8640/87
CALIBRATED BY NOEL D. SMITH RSO Q.A. MANAGER, KEVIN E. SMITH Q.A. TECH., OR QUINTIN STOKLEY Q.A. TECH.

SIGNATURE: ______ DATE: 06-DEC-1995

INSTRUMENT RANGE mR/hr	INSTRUMENT READING mR/hr	CAL. REFERENCE POINT mR/hr	AS RECEIVED READING mR/hr
0 - 10,000 0 - 1000 0 - 100 0 - 10 0 - 1		2000 - 8000 200 - 800 20 - 80 2 - 8 0.2 - 0.8	
0 - 2000 0 - 200 0 - 20 0 - 2 0 - 0.2	55 - 150 5.2 - 15.0 0.52 - 15.0 0.10	500 - 1500 50 - 150 5 - 15 0.5 - 1.5 0.10	58 - 170 4.8 - 14.0 0.52 - 15.0 0.10
0 - 500 0 - 50 0 - 5 0 - 0.5		100 - 400 10 - 40 1 - 4 0.1 - 0.4	

REV.D 02-20-95

sahci Consultants to Nuclear Medicine • Radiology • Nuclear Industry

STAN A. HUBER CONSULTANTS, INC. □ 200 NORTH CEDAR ROAD □ NEW LENOX, IL 60451 □ (815) 485-6161 □ FAX (815) 485-4433

December 15, 1994

U.S. Army Armament
Munitions and Chemical Command
Attn: Walter Prisk, AMSMC-DSM-E, DSN 793-5974
Rock Island, Illinois 61299-6000

RE: Suggestion for Feasibility Analysis

Subject: **Proposal to use some of AMCCOM Depleted Uranium as Shielding Material at Russian Reactor Incident Sites**

Dear Mr Prisk:

This proposal is a suggested additional usage of Depleted Uranium (D.U.) projectiles of AMCCOM, in addition to our already pending proposal to manufacture D.U. shielded containers for use at U.S. government facilities or the private sector, for shielding of radioactive materials in storage, transport or disposal. The basic products we previously proposed are 30 and 55 gallon sized drums, although 19 gallon and other sizes are feasible. We manufactured a prototype 30 gallon shielded container, tested its performance and issued a feasibility report to AMSMC-PCC/Ms Demi Owens; Rock Island, Illinois dated December 30, 1993.

Background

The continuing radiation hazards at Chernobyl, Chelyabynsk and other locations in Russia are well known. Stan A. Huber Consultants, Inc. has already been contacted by a U.S. firm which has a twenty (20) year license to ship NORM (Naturally Occurring Radioactive Material) to Chernobyl for use as shielding material.

Objective

Our opinion is that Depleted Uranium could be used to provide much improved shielding at locations such as Chernobyl and could perhaps save lives and at least aid in preventing further radiation releases or unnecessary radiation exposures. At the same time, the U.S. could obtain good-will by providing effective shielding blocks and convert much of its unneeded D.U. stock-pile into usable products instead of incurring storage costs and exorbitant waste disposal fees.

The Proposed Product

The proposed product would be a 44 gallon square container, "block shield" filled with D.U. projectiles and concrete. The reason for the square shape is to avoid shielding gaps that would otherwise occur with typical round barrels. Also, Stan A. Huber Consultants, Inc. knows that 44 gallon square containers are commercially available, although quotes for other size square drums and lids could also be obtained. It may be possible to use round drums, if they are staggered properly at the usage areas to be shielded.

The Projected Costs

Other than the cost of materials and labor, we know a firm that could transport the finished block shields to Chernobyl for an estimated $45 per cubic foot. This is considerably less expensive than the combination of transport and disposal costs within the U.S. Of course, it is possible that the U.S. Government or Army would want to do its own transport of the finished block shields to Chernobyl, if it believes it can do those transport, export, and moving activities for lower costs. This estimated cost data is provided as a ball-park figure for discussion purposes.

Manufacturing

It should be much easier to make the completely filled "block shields" compared to the D.U. shielded containers, because there is no need for creating content cavities in the drums with pipes or Sono tubes. Therefore, the cost per item would be reduced, compared to shielded drums. (It may be possible to use such block shields at DOE facilities)

Recommendation

We recognize this proposed use of part of the AMCCOM stock pile of D.U. projectiles falls in the categories of international good- will, foreign aid or diplomatic politics. However, it seems worthwhile to suggest this concept to the appropriate managers and political contacts, to determine their perceptions of the merits and feasibility.

Respectfully submitted,

Stan A. Huber

Stan A. Huber
President

SAH:jjz

Stan A. Huber Consultants, Inc.
sahci
Health Physics and Radiation Safety Services
200 N. Cedar Road — New Lenox, IL 60451-1751
1 (800) 383-0468 or 1 (815) 485-6161 FAX 1 (815) 485-4433
http://www.pchydrm.com/sahci — E.mail: SSQC17A@Prodigy.com

FAX TRANSMISSION COVER SHEET

Date:	12/8/95
To:	Bill Meyer SIOAC-DEV
Facility:	US Army
Fax Number:	815-273-8811
From:	Joel Ahrweiler
No. of Pages (Including Cover Sheet)	18
	IF ALL PAGES ARE NOT RECEIVED, PLEASE CALL (815) 485-6161

MEMO:

Bill here is a copy of the latest D.U. Drum Procedure, also attached are the MSDS sheet for Portland type 1 cement + Fine Hematite aggregate

Stan A. Huber Consultants, Inc.
200 North Cedar Road
New Lenox, IL 60451

Phone:(815) 485-6161 Fax:(815) 485-4433

55 Gallon Depleted Uranium Shielded Container

Procedure Manual

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55 GALLON DEPLETED URANIUM SHIELDED CONTAINER - MATERIAL LIST

(1) 55 GALLON DRUM - UN SPEC. A2/Y1.5/150/91, Steel, black
Supplier: Skolnick Industries, Inc. or equivalent UN SPEC# Drum supplier
Dean Ricker
4900 S Kilbourn Ave.
Chicago, IL 60632-4593
(312) 735-0700

(130 lbs) PORTLAND CEMENT - TYPE ONE, manufactured by Essroc, 94 lb bags
Supplier: Handy Andy or other hardware store

(345 lbs) FINE HEMATITE AGGREGATE
Supplier: Nuclear Shielding Supplies and Service
Manjit Chopra
45656 S Palo Verde, Suite 203
Tucson, AZ 85714
(602) 748-9362

(6 oz.) SUPER PLASTICIZER - DARACEN 100
Supplier: Meyer Material or other supplier of DARACEN 100
RR 1 Bluff Rd
Channahon, IL 60410
(815) 467-2236

(1) 10" SONO TUBE - 3/16" thick fibre form, 23 inches long
Supplier: McCann Construction Specialties Company *
303 Republic Ave.
Joliet, IL 60435-6519
(815) 744-5511

(1) 16" SONO TUBE - 1/4" thick fibre form, 28 inches long
Supplier: McCann Construction Specialties Company *
303 Republic Ave.
Joliet, IL 60435-6519
(815) 744-5511

(143 lbs) SAND - coarse, all purpose, Torpedo brand, 50 lb bags
Supplier: Smith Brothers Garden Center *
2601 E Lincoln Highway
New Lenox, IL 60451
(815) 485-9420

(260 lbs) COARSE AGGREGATE - 5/8" Diameter Meramec stone (small)
Supplier: Smith Brothers Garden Center *
2601 E Lincoln Highway
New Lenox, IL 60451
(815) 485-9420

(2) EYE BOLTS - 1/2" x 4" Thread Length
Supplier: Handy Andy or other Hardware Store

(2) NUTS - 1/2" Thread (for use w/ Eye Bolts)
Supplier: Handy Andy or other Hardware Store

(4) WASHERS - 2" Diameter (for use w/ Eye Bolts)
Supplier: Handy Andy or other Hardware Store

(300) DEPLETED URANIUM PROJECTILES - (# is approximate, 280 $\pm$ 60 projectiles)
Supplier : US Army
Projectiles are used as aggregate, similar to gravel stones with cement to make concrete.

(52 lbs) WATER - (amount not in gallons, so weight is approximate)

*= or equivalent construction goods supplier

MIXING THE HIGH DENSITY CONCRETE

In order to mix the batch of concrete, a large basin or concrete mixer will be needed. The following materials compose 1 batch of high density concrete:

INGREDIENT	AMOUNT IN LBS
Portland Cement	10 *
Water	6 *
Coarse Aggregate (5/8" Diameter)	20 *
Sand	11 *
Fine Hematite	26.5 *
Super Plasticizer	0.5 oz

* The above amounts can easily be varied by at least ± 20 % for each item, depending upon such factors as humidity and or dryness or physical characteristics of the cement aggregate, sand, and hematite.

The batch can be any size, just as long as the ingredients are a multiple of the above amounts. For example, if you were going to produce several drums and did not want to mix up each batch individually, you could multiply all of the ingredients by 2 or any other number that gives you a workable batch size.

All of the ingredients should be mixed by hand or machine until there is no standing water. There should not be any unmixed portions in the batch and the result should be a cement-like homogeneous mixture. For optimal performance, the concrete should be mixed in temperatures between 50 and 80 degrees Fahrenheit. Mixing the concrete in extreme temperatures will affect the curing process.

After curing, the water will have dried up. The 67.5 lb. batch of concrete will need 6 lbs. of water. The ingredients should be composed of these approximate percentages, by weight:

Portland cement	14.8%
Coarse Aggregate:	29.6%
Sand:	16.3%
Fine Hematite:	39.3%

The plasticizer does not have an effect on the overall weight of the container, but it aids in the curing process. The plasticizer is one ingredient of the mix that needs to be weighed out very precisely. There should not be more than 1 oz. of plasticizer per 100 lbs of mix.

POURING THE BASE

Once the high density concrete has been mixed, the base of the drum should be created. Carefully, pour the mixture into the 55 gallon drum until there are 4 inches of concrete. After 4 inches of concrete are poured, the drum needs to be shaken manually, or vibrated. It is essential that all air pockets are removed, because any gaps will take away from the shielding potential of the container.

The drums <u>must</u> be manufactured on a level surface. If the concrete is poured on a non-uniform surface, the performance of the drum will be greatly reduced. It is a good idea to build the drums on pallets so that they can be transported easier later. Using a fork truck to lift the drums individually before they have cured could cause damage to the different layers. The completed container will weigh up to 1600 lbs and can not be transported very easily without the proper equipment.

After the first four inches of concrete have been poured, the first sono tube needs to be placed. Take the 16" diameter sono tube and place it directly in the center of the drum. The sono tube must be centered so that the distance between the sono tube and the drum are equal all the way around. Any variation will have a significant effect on the shielding capabilities.

The sono tube needs to be placed at a 90 degree angle to the base of the drum. Once the sono tube is centered and leveled, push the tube 2 inches into the concrete base. To double check the alignment of the sono tube, measure the distances between the tube and the drum again, and use a level to make sure it is at the correct angle.

FILLING THE OUTER WALLS

Up to this point, the base of the container has been poured and the outer sono tube is firmly in place. The next step is to complete the outer walls and insert the inner wall.

Make up several more batches of high density concrete. Take the mixture and carefully fill up the outer wall between the sono tube and the drum. Fill the sides with concrete until it is even with the top of the 16" sono tube. The sono tube might be knocked slightly out of place during this process, so measurements and a level test should be taken as a precaution. This outer wall of high density concrete will be approximately 3 1/2 inches wide, all the way around the container.

After the concrete has been poured and is even with the sono tube it should also be within 2 to 3 inches from the top of the drum, now you will need to insert the inner sono tube. This tube should also be centered and leveled. Follow the same steps that were taken to insert the first tube. Carefully, insert the 10" sono tube into the base, which should still be wet. Push it firmly into place, once again checking that the distances between the inner sono tube and the outer sono tube are equal all the way around.

At this time you will have the base and the outside walls poured with both the 16" sono tube and the 10" sono tube in place.

APPLYING THE D.U. PROJECTILES

This step is the most difficult to perform. The D.U. projectiles are part of the nuclear shielding, so there will be three inches of high density concrete and projectile mix on all sides and the bottom. Later, when the lid is manufactured, it too will have three inches of high density concrete and projectiles mix.

Start by filling the bottom of the inner cavity with projectiles three inches deep. Due to the fact that the sono tube diameters can vary up to an inch in size, the exact number of projectiles can only be estimated at 26 ($\pm$ 5 projectiles) for the inner cavity base. There should be an attempt made to fit as many projectiles in the allotted 3 inch space as possible. There will be small gaps in between the D.U. projectiles so a small amount of concrete will have to be applied. All of the gaps between the projectiles must be filled with concrete to assure optimum performance of the finished container. Because the concrete has to fill the gaps, a special concrete mixture has to be used. Fine hematite will be increased to 46.5 lbs. per batch and coarse aggregate will be eliminated. Other than increasing the fine hematite and eliminating the coarse aggregate, the mixture is exactly the same as it was for constructing the outside cavity and the base.

At this time there will be a solid base of concrete and D.U. projectiles mix three inches deep. This fills three inches of the inner cavity. Next, the walls of the middle cavity will need to be constructed.

Place about 30 D.U. projectiles around the middle cavity. Then pour a small amount of high density concrete mixture to fill in the gaps between the projectiles. The projectiles are to be treated as aggregate in a concrete mix so the exact placement is not of importance other than the fact that it is desirable to use as many projectiles as possible. Repeat these steps of placing projectiles and filling the gaps until you near the top of the container. Stop filling the walls with D.U. when you are an inch away from the top of the 10 inch sono tube. This inch should be filled with high density concrete only. Once again, due to sono tube variation the exact number of projectiles can only be estimated at 225 ($\pm$ 45 projectiles) for the container walls only. This middle layer will be approximately 3 inches wide all the way around the container.

The D.U. projectile layer will be five inches shorter than the outside concrete layer, and between seven and eight inches from the top of the drum.

At this time you should have an outside wall of high density concrete (2 to 3 inches from the top of the drum), a middle wall of high density concrete and D.U. projectiles mix (7 to 8 inches from the top of the drum), and an inner cavity. The gap left over between the outer wall and the inner wall will be filled by the lid. (to be constructed later)

POURING THE LID

When mass producing shielded containers, a wooden form would be used to make the lids. However, using a scrap piece of sono tube is much more efficient when only building a few containers. Both the cardboard sono tube and the wooden form produce the same lid, so the following process can be followed for both.

If you don't have a wooden form, take a 16 inch sono tube and cut a small strip out of the tube from top to bottom. Re-attach the two free sides of the sono tube with duct tape. In a sense you will be creating a 15 1/2 inch sono tube. A regular 16 inch sono tube can not be used because the lid needs to fit inside the outer wall, and be able to be removed easily.

Take the newly created 15 1/2 inch sono tube and attach it to a piece of wood or cardboard on a flat, level surface with a layer of sheet plastic between. Instead of having a wooden form, you have created a cardboard form that can be discarded after production of the lid.

First, pour one inch of high density concrete into the bottom of the form. Then take D.U. projectiles and place them laying down (just like the base). However, in the case of the lid, one inch of concrete will need to be around the outside of the lid. There should not be any projectiles within one inch of any wall of the lid. Fill in the gaps and the outside inch with high density concrete. Repeat this step three times, each time constructing another layer.

At this time, the bottom inch will be all high density concrete and the next three inches D.U. projectiles and concrete. Finish the lid off by pouring one inch of high density concrete over the top of the form. The finished lid will be approximately 15 1/2 inches in diameter and 5 to 5 1/2 inches tall. The core of the lid will be made of approximately 32 ($\pm$ 6) D.U. projectiles, while the outside inch of the entire lid will be concrete only.

The last step is to take the Eye bolts with the washers and nuts and insert them into the lid with the eyes exposed. Once the concrete has cured, the eye bolts will provide handles, so the lid can be moved when necessary. The finished lid will fit inside the outer wall, sitting on top of the middle wall.

CURING PROCESS

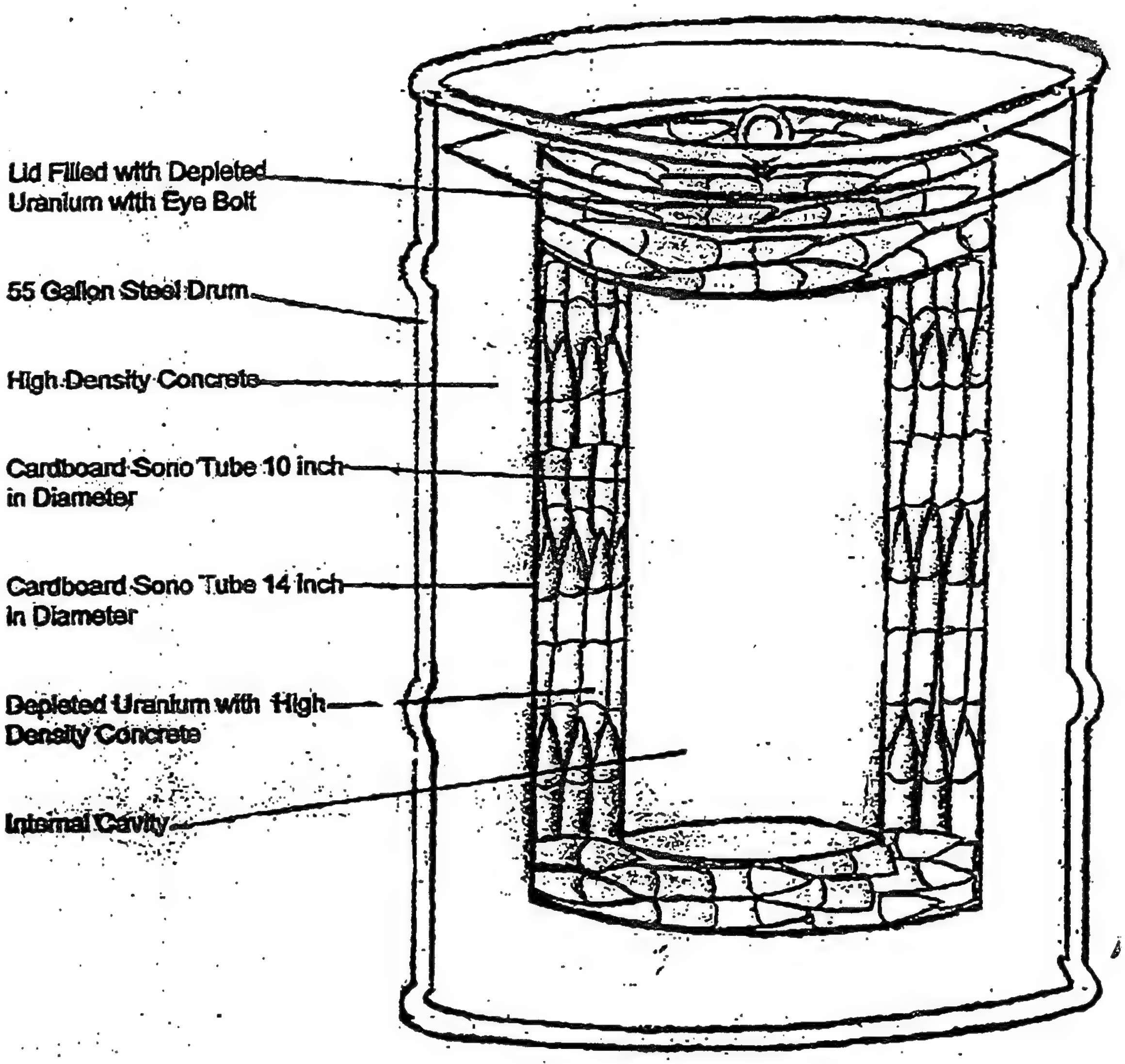
There are several things that will help the containers to cure properly. First of all, the containers should not be moved for at least 48 hours. After two days the concrete will be fairly secure but still should not be transported. The container takes a full twenty-eight days to cure totally. After that time they can be moved freely and used to store and transport radioactive materials.

The twenty-eight day curing time the containers should be stored in a dry place. Do not put the lids on the containers because the water will need to evaporate from the concrete. Sealing or covering the drum will greatly extend the curing process.

The containers also should be kept in the same temperatures in which they were built (between 50 and 80 degrees). Freezing temperatures during the curing process could cause the concrete to crack. The containers should also not be exposed to water.

After the containers are completed they need to be labeled "Caution - Radioactive Shielding Uranium". See attached sample label. Stencilling can also be used. Height of letters in the label is not specified in the regulations [Title 10 CFR Part 40.13 (c)(6)(i)].

DIAGRAM OF COMPLETED CONTAINER



NOTE: The side walls of D.U. shown on the above sketch show the projectiles to be neatly stacked vertically. In manufacturing, it is neither projectile nor necessary to arrange the projectiles in this manner, since they are as aggregate, similar in density to the high density concrete.

Material Safety Data Sheet [OSHA 29 CFR 1910.1200]

IDENTITY

Product Name: Portland Cement (Type I, II or IA)
Product Code: 1124

SECTION I

Manufacturer's Name and Address

The QUIKRETE Companies
1790 Century Circle
Atlanta, Georgia 30345

Emergency Telephone Number

(404) 634-9100

Information Telephone Number

(404) 634-9100

Date of Preparation

January 1, 1988

SECTION II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components	CAS No.	OSHA PEL	ACGIH TLV 3 MG/M	Other Limits Recommended
	65997-15-1		5	

SECTION III - PHYSICAL/CHEMICAL CHARACTERISTICS

Solubility in Water - Slight
Gray colored with no odor

The following properties are not applicable: Specific Gravity, Boiling Point, Vapor Pressure, Vapor Density, Melting Point, Evaporation Rate.

Material Safety Data Sheet
Product Name: Portland Cement (Type I, II or IA)
Product Code: 1124

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Noncombustible and not explosive.

SECTION V - REACTIVITY DATA

Stable

Is not incompatible with other materials, will not decompose into hazardous by-products and will not polymerize.

Keep dry until used to preserve product utility.

SECTION VI - HEALTH HAZARD DATA

Classified as a nuisance dust by OSHA, MSHA and ACGIH. As such, the TLV is 5 mg/m3 for respirable dust and 10 mg/m3 for total dust. Not known to cause cancer. Exposure can affect the skin, the eyes and mucous membranes.

Acute Exposure: Can dry the skin and cause alkali burns. Dust can irritate the eyes and upper respiratory system.

Chronic Exposure: Dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis.

Emergency First Aid Procedures: Irrigate (flood) eyes immediately and repeatedly with clean water. Wash exposed skin areas with soap and water.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

If spilled can be cleaned up using dry methods that do not disperse dust into the air. Avoid breathing the dust. Emergency procedures are not required.

Can be treated as a common waste for disposal or returned to the container for later use if it is not contaminated or wet.

SECTION VIII - CONTROL MEASURES

In dusty environments, the use of an OSHA, MSHA or NIOSH approved respirator and tight fitting goggles is recommended.

Local exhaust can be used, if necessary, to control airborne dust levels. The use of barrier creams or impervious gloves, boots and clothing to protect the skin from contact is recommended. Following work, workers should shower with soap and water. Precautions must be observed because burns occur with little warning -- little heat is sensed.

NUCLEAR SHIELDING SUPPLIES & SERVICE
4620 SOUTH COACH DRIVE
TUCSON, ARIZONA 85714

TELEPHONE: (520) 748-9362 FAX: (520) 748-9364

MATERIAL SAFETY DATA SHEET

GENERAL INFORMATION

Manufacturer: Nuclear Shielding Supplies & Service
4620 South Coach Drive
Tucson, Arizona 85714

Creation Date: 10/90

Revision Date: N/A

For Additional Information, Contact:

Phone: 520/748-9362
Fax: 520/748-9364

MSDS Code: H. AGG.F

PRODUCT IDENTIFICATION

Product Name: High Density Fine Aggregates

Formula: Fe_2O_3

Synonym(s): NA

Chemical Family: Oxides of (1) Iron (Hematite)

TYPICAL CHEMICAL COMPOSITION

General Chemical Analysis (Typical)

%	
Fe	65.93
P	0.006
SiO_2	5.31
Al_2O_3	0.31
MgO	0.018
CaO	0.015
Mn	0.13

Permissible Air Level

OSHA PEL	ACGIH TL
NE	NE

Footnotes:

(1) See last page for important additional terms and conditions including disclaimer of warranties.

(2) Concentration may vary somewhat between batches or lots. Where possible, a concentration range is indicated. Occasionally, however, levels may even fall outside of the usual concentration range.

(3) Common names, if applicable, appear in parenthesis following the chemical names.

PHYSICAL DATA

Physical State: Fine Granular

Bulk Density: 185 - 210 lbs/ft^3

Appearance and Odor: Gray Color, Odorless

Vapor Pressure: NA

Boiling Point: NA

Vapor Density: NA

Melting Point: over 1200°C

Evaporation Rate: NA

pH: NA

FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method): NA

Lower Explosive Limit: NA

Auto ignition Temperature: NA

Upper Explosive Limit: NA

Fire Hazard: Non Flammable

Explosion Hazard: NA

Extinguishing Media: NA

Special Fire Fighting Procedures: NA

Unusual Fire and Explosion Hazards: NA

REACTIVITY DATA

Stability: Stable

Incompatibilities (Materials to Avoid): Strong mineral acids eg. HCl, H_2SO_4, HNO_3.

Hazardous Thermal Decomposition Products: None Expected

Polymerization: Will not occur

HEALTH HAZARD DATA

Proper precautions should be taken to avoid any health hazard. A health hazard may occur if limits for air contaminants exceed PEL limits as per 29 CFR 1910.1000. Proper engineering controls and ventilation should be used to prevent air contaminants from exceeding PEL limits. (For information on potentially hazardous elements refer to page 3.)

Usual Route(s) of Entry: Inhalation

Medical Conditions Possibly Aggravated: Chronic diseases or disorders of the respiratory system.

Carcinogen Information: Not considered to be a carcinogen.

--------------FIRST AID AND MEDICAL EMERGENCY PROCEDURES----------

Eye Contact: Not anticipated to pose an acute or significant eye contact hazard.
Skin Contact: Not anticipated to pose an acute or significant skin contact hazard.
Inhalation: Not anticipated to pose an acute or significant inhalation hazard.
Ingestion: Not considered to be an ingestion hazard.

--------------OCCUPATIONAL EXPOSURE CONTROL MEASURES--------------

Engineering Controls (Ventilation, etc.): Ventilation should be sufficient to maintain dust levels below applicable exposure limit.
Work Practices (Handling and Storage, etc.): Avoid creating airborne dust by dust suppression methods.
Eye Protection: Safety glasses or goggles are recommended when dust levels are excessive.
Skin Protection: Gloves and long-sleeved clothing are recommended when dust levels are excessive.
Respiratory Protection: When engineering controls are not sufficient to lower dust levels below the applicable exposure limit, use a NIOSH-approved respirator for dusts and mists within the use limits of the respirator.

--------------SPILL, LEAK AND DISPOSAL INFORMATION---------------

Procedures to Follow if Material is Released or Spilled: Material should be swept or vacuumed into appropriate containers.
Waste Disposal Method(s): Landfill disposal or other methods which are in accordance with local, state and federal regulations. Wastes may be reclaimed or salvaged for further use.

------------ADDITIONAL MISCELLANEOUS INFORMATION----------------

NONE

Abbreviations:
NA = Not Applicable
NE = Not Established

The Ilmenite Aggregates do not meet the criteria of hazardous chemicals as defined by the Federal Occupational Safety and Health Hazard Communication Standard 29 CFR 1910.1200 (c). This form is being provided solely as General Information and should not be construed as a determination that the product is a hazardous chemical. All sales of this product are subject to Nuclear Shielding Supplies & Service's standard terms and conditions of sale. NSS makes no warranties, express or implied, including the Implied Warranty of merchantability. Any implied warranty of fitness for a particular purpose or any implied warranties otherwise arising from course of dealing or trade.

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